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Transactional Interactions and Growth in the Global Economy: A Multiple-Network Analysis.

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TRANSACTIONAL INTERACTIONS AND GROWTH IN THE GLOBAL ECONOMY: A MULTIPLE-NETWORK ANALYSIS

A Dissertation

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Kuo-Hua Chen
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In memory of my beloved father, Yu-Dong Chen

(August 10, 1937 - June 10, 1995)

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ABSTRACT

This dissertation postulates that the trend of increasing globalization of economic activities within the shifting features of the world economy has been the dominating force transforming and integrating the international economic structure. I adopt ecological theory's external view of system structure, and focus on a more relational view of international exchange. Using network methodology, I analyze the effects of global transactional interactions on economic growth.

This research extends concepts of the macro-urban approach to an analysis of international transactions. Based on data for 93 nations over a 20-year period (1970-1978 and 1978-1990) from three transactional networks (93 x 93 matrices), major effects of international trade, capital, and labor flows on global economic structure and growth are carefully examined. Results indicate that economic interdependencies developed in terms of network positions and changes in the network centralities have been pivotal determinants in reorganizing international economies and creating competitive advantages for economic growth for countries centrally located in the global production networks.

Applying difference-of-logs (growth rate) models, the results present robust positive effects of transactional networks on economic growth net of four groups of

alternatively hypothesized determinants (dependence, industrialization, human capital investment, and military expenditure). The results indicate that increased transactional linkages with the international economy have been beneficial rather than harmful to economic growth. I conclude that structural position in external transaction networks has been the critical factor affecting growth and transformation in the world economy.

CHAPTER ONE

INTRODUCTION

Economic Growth is a pivotal subject in macrosociology. The trend of increasing globalization of economic activities within the shifting features of the world economy is the dominating force affecting restructuring in the international economic hierarchy and the growth of national economies. Research has been preoccupied with dependency/world-systems theory focusing on the harmful or exploitative effects of asymmetric international exchange. Moreover, involvement in the global system, as measured by position in the world system, and various internal determinants are emphasized beyond any external elements.

In this dissertation I adopt ecological theory's external view of social and spatial hierarchy and socioeconomic structures. I focus on a more relational view of international exchange, and how it affects global economic structure and growth relative to internal variables. Considering influences from an exceptionally "internationalized" world, Evans and Stephens (1988) claim that transactional flows that cross national boundaries have become increasingly important relative to those that move within them. Hence, a country's structural position in multiple-transactional networks are important theoretical

and empirical determinants of interareal relations. Networks of trade, capital, and labor flows are considered to be the critical variables necessitating change and growth in the world economy.

Network analysis has recently been employed in research on political and economic structures of the global economy, and on the configuration and stratification of the world system. Irwin and Hughes (1992) argue that concepts of structural position in external transaction networks are emerging as a central theoretical issue across all socio-spatial approaches. Previous research applying network analysis to the world systems (Nemeth and Smith 1985; Smith and White 1992; Snyder and Kick 1979) was restricted by measures of network position (global blockmodeling) and correspondent data sources (binary symmetric matrices). However, I employ Bonacich's (1987) centrality concepts and measures which have been successfully employed in macro-urban analysis (Irwin and Kasarda 1991; Irwin and Hughes 1992), and extend this national socio-spatial analysis to international exchange networks. Moreover, data on trade, capital, and labor flows are all available in matrix-type, and coded as continuous flows instead of binary forms. Hence, analysis using centrality concepts and measures is particularly appropriate in testing competing theories that stress the importance of global economic exchange. Drawing on ecological theory, I expect that a global hierarchy can

be identified based on flows of international trade, capital, and labor, and such a hierarchy is formed as a continuum of roles rather than a stratified model or discrete clusters of countries. Besides, vertical (upward or downward) mobility is likely to occur for countries across geographical regions or economic levels.

I employ another measure of network centralization, based on Freeman's (1979) measure but modified to take account of the standardized centrality scores. The objective of using this measure is to test the degree to which network flows in the world economy are dominated by a few countries. I argue that a growing interdependence and multilateralization of various trading blocs will lead to a decentralization in the global economy over time. Eventually, the world economy is likely to result in a multicentric rather than hegemonic structure.

Examining the effect of global network position on national economic growth, I hypothesize that integration into the international community is necessary for growth. Moreover, increased transactional linkages with the international economy should boost rather than impede a country's economic growth. On the contrary, theorists of the political economy perspective insist that international exchanges are implacably opposed to Third World interests, and suggest that cutting ties with the international economy is the best development strategy. Nevertheless, the

increased adoption of market mechanisms and correspondent outcomes for economic growth, compounded by secular technological improvement, especially in transportation and communication, may further stimulate international interactions through various exchange networks. These trends of development seem to suggest that nonincorporation or marginalization in the world-system may bring the severest problems of all (Callaghy 1984; Iliffe 1987; Mytelka 1989).

Further still, four groups of alternatively hypothesized determinants of economic growth (dependence, industrialization, human capital investment, and military power) are introduced in the multiple regression analysis to contrast their relative effects with network centrality measures in determining national economic growth. Finally, three measures of economic growth (growth rates of GNP per capita, The Physical Quality of Life Index, and Human Development Index) are included to evaluate the relative validities of competing measures and theories.

Concerning potential problems of modeling and measurement of economic growth, special attention is paid to the model's overall coherence in conducting this cross-national research. In addition, to avoid biases mainly due to unmeasured variables, difference-of-logs (growth-rate) models are employed throughout the regression analyses.

Based on data for 93 nations[1] over two time periods, 1970-1978 and 1978-1990, dynamic changes in the structure and hierarchy of the world economy are carefully examined.

Significance of this research

This research is a theoretical synthesis of various factors on the studies of global structure and economy. By examining essential elements and arguments of each theoretical approach, the present research generates a distinctive approach for the analysis of the world economic system. Unlike the diffusionist perspectives and political economy approach, a multiple-network analysis necessitates thorough examinations of international exchange patterns and their effect on national economic growth.

Second, the present research contributes to empirical designs in network analysis. Bonacich's (1987) centrality measure is utilized to explore the dynamic configurations of the world economy system, and to elaborate the empirical status of world-system models. Previous research (Nemeth and Smith 1985; Smith and Nemeth 1988; Smith and White 1992; Snyder and Kick 1979; Steiber 1979) suggests that social-network analysis could be usefully employed in

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[1]In the multiple regression analyses, the number of nations is reduced to 72 due to incomplete data for some alternative determinants at all three time points. See appendix 3 for countries included in the multiple network analysis.

studies of international relationships between countries. Although the preceding "global blockmodeling" network approach may be conceptually appropriate to the analysis of international exchange patterns, this research asserts that techniques used for measuring (or blocking) a country's structural position are not appropriate. Instead, an alternative approach based on Bonacich's general centrality measure is used. Three measures of centrality, each based on an alternative concept of network positions, delineate and differentiate various exchange patterns of global economic structures.

Third, this research addresses empirical lacunae in ecological research by extending theoretical concepts developed in national studies (such as dominance and hierarchy) to the analysis of cross-national structure. This approach equips conventional development theories with practical and vital ecological principles rather than pervasive influences of cultural factors or power relations to explain the world economic system.

Furthermore, this multiple-network analysis enhances the theoretical development of international political economic research. The research presents a hierarchical model of the world system that is based on three essential types of international economic networks: trade flows, capital dominance, and labor flows. These multidimensional transaction flows reflect Wallerstein's (1974) emphasis on

the dominant institutional nexus -- capitalism (balance of trade, capital accumulation, and labor exploitation) and dependency theorists' focus on sources of dependence in the world capitalist economy. Additionally, these transaction flows correspond to mainstream economists' stress on interactions between flows of products (economic exchange) and flows of production factors (labor, capital and economic organization). Research using a blockmodeling network approach were constrained to limit analysis either exclusively to trade circuits or other binary-typed international network matrices such as military, diplomatic, and cultural ties.

Economic outcomes in the present research are measured using three prominent dependent variables (growth rates of GNP per capita, PQLI, and HDI). These dependent variables are derived from two major conceptual camps - the political economy of growth and diffusionist perspectives. These multiple indicators capture different dimensions of development. However, using multiple indicators of economic development addresses several problems inherent in international research. First, there is a lack of consensus on the definition of economic development (Morris 1984). Second, measures of economic development encounter an "indexing" problem (Bollen and Appold 1993). Accordingly, empirical research results in various problems including a) problems of excessively narrow definition of economic

development,[2] b) the use of a single dimension of development, and c) problems of smaller samples. The present study therefore contributes to the on-going debate on the construction of indicators by evaluating the relative validities of the most significant measures of economic development.

Finally, this research provides a dynamic analysis of the structure of the international system. By examining three transactional networks in the international system across two time-intervals (1970-1978, 1978-1990), this dynamic design provides a vigorous image of the internationalization of markets, commodities, capital, and labor. This dynamic approach also allows us to compare and contrast the transitional effects among centrality measures and other internal and socio-political determinants of economic growth. Smith and White (1992) point out that this is particularly relevant in the years between mid-1960's and 1980's because it is a purported period of hegemonic decline. Most importantly, patterns and cycles of hegemony in the world-system are an important theoretical and empirical issue in international political economy (Arrighi 1982; Bousquet 1980; Schurmann 1974; Wallerstein 1974). Besides, there has emerged in the previous decade a new trend of regioncentric strategy and the importance of

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[2]See Stokes & Jaffee, 1982; Firebaugh and Bullock, 1987; Stokes and Anderson, 1990; and Bollen and Appold, 1993.

understanding the uniqueness of a regional trading bloc within a world trade area (Kiel and Howard 1988; Hansen et al. 1990).

CHAPTER TWO

LITERATURE REVIEW

Theoretical Background

In the first part of this section, major theoretical perspectives within the literature of development theory will be compared and contrasted according to their key components. Note that each theoretical approach will be viewed as a coherent whole although there are almost as many variants of the earliest approach as there are in the most recent one.

The most famous formulation in studies of economy and society was laid out by W. Arthur Lewis (1955) that "the advantage of economic growth is not that wealth increases happiness but that it increases the range of human choice." Neoclassical economic theorists' arguments on comparative advantage (Klein, Palty and Voisin 1982; Linnemann 1966) and Rostow's (1971) well-known theory on "The Stages of Economic Growth" follow the tradition concerning the effect of the industrialization and modernization of society on the quality of life of the national population. The same concern was articulated in the 1970s by the ILO's "basic human needs" program (Todaro 1992). Recently, the basic needs approach to underdevelopment was further fruitfully elaborated (for example, Crosswell 1981; Friedmann 1979; London 1987; London and Williams 1988; London and Smith

1988; Streeten and Burki 1978; Wimberley 1990, 1991; Wimberley and Bello 1992) in an attempt to explore the interaction effects of both international economic exchanges and intranational political processes on development.

The emergence of modernization theory in the late fifties and early sixties set the stage for the contemporary synthesis. The body of literature built around the concept of modernization was the first substantial set of writings by mainstream sociological and political scientists that focused on what was happening in the Third World (Evans and Stephens, 1988). According to modernization theory, economic and social development is a unilinear and evolutionary process. Modernization theorists emphasize the social, cultural, and psychological constraints on economic development. Hence, a western model of capitalism is set up for the poor countries, namely, poor countries should follow the path established by developed nations, moving as rapidly as possible from "traditional" agricultural societies to "modern" urban-based economies (see Kelley and Williamson 1984).

Stated more specifically, modernization theory can be characterized as a theory of underdevelopment because its theoretical framework concentrates on the negative phenomena and manifestations of Third World societies and their effects on economic growth. Consequently, the

paradigm of success in the western developed countries as dominant content of world culture has been adopted in the argument of international relations (Meyer et al., 1975; Boli-Bennett, 1979, 1980; Meyer, 1980). Clearly, modernization theory neglects the uniqueness of each culture and social structure, and the significance of historical context within each country. Furthermore, as international transactions are becoming increasingly important, a series of critiques was raised. This trend of development theories that dominates development economics and government policy-making in western societies can be grouped and called the diffusionist perspectives (see Wimberley 1990).

Challenges to modernization theory primarily point to its neglect of international factors and its conservative neoclassical sociological and economic premises. Due to a great wealth of variants existing within this camp of theoretical debates, they will be categorized and characterized as the political economy perspectives. In the early 1970's, the emergence of dependency/world system theory and international relations captured all the attention in this field.

Political economy perspectives draw heavily on Marxist theory. Therefore, theorists supporting this trend focus more on the asymmetric Third World development. In addition, the sovereignty of the nation-state and economic

influences arising from capitalism are the core topics. More importantly, it emphasizes the inevitability of stratified structures within the world system. As Mary Douglas (1986) refers to the parity argument in early Greek thought "recurrent appeal to pairs of opposites of various sorts both in general cosmological doctrine and in accounts of natural phenomena," the reference can be made to the contrast position of "strong" and "weak" within the world system. A similar argument can be found in Dahrendorf's (1959) theory. The structure of a social formation remains the same, dominant and dominated groups, but the occupants change. Virtually all empirical research reaches the same conclusion, that is, the world system is a stable stratified structure with a different composition over time (Snyder and Kick, 1979; Bollen, 1983; Nemeth and Smith, 1985; Smith and White, 1992).

However, major disagreement can be found within the political economy perspectives. The focus is the debate over the absolute importance between political and economic sectors. They are known as the literature of international relations and world-system theory, respectively. Theorists of international relations emphasize the notion of state dominance, which postulates politics as ideology developed by capitalist economies to maintain the status-quo in the world stratification structure. In other words, economic success will never happen in the periphery countries, but

only provide the convenience for state elites to increase power and control internally. One of the most important figures in the theory of nation-state dominance, Boli-Bennett (1980), developed a global integration perspective. He states that dominance is measured by integration into the entire system, which is the degree to which the local economy is oriented to the world economy, the degree to which local politics reflect developments in world politics, the degree of penetration of "world culture" into the local culture, and so on. He contends that the world system contains a fairly coherent and uniform set of ideological and organizational standards for national behavior. Hence, both ideology and organizational implementation of ideology support the expanded dominance of the state as the primary mechanism for achieving success (Boli-Bennett, 1980).

Furthermore, Boli-Bennett's global integration perspective emphasizes the stability of the nation-state. As Meyer (1980) explains: "Nation-states almost never break up, and almost never really unite; boundaries rarely change, despite all the flows and changes of interests and power in the system." However, Meyer's argument may not be valid when applied to the current situation of contemporary Eastern Europe. Carroll's (1984) argument on macroevolutionary level of organizational ecology should be more appropriate for analyzing the stability of the nation-

state. Carroll states "macroevolution posits selection of organizational forms as manifested through rates of form emergence and survival against extinction." It is apparent that nation-states are durable organizations, yet the organizational forms did change frequently according to long-term historical transformations.

Wallerstein's (1974) world-system theory depicts the importance of specific social structures within an historical context, and its connection with the emergence of a European capitalist world-economy. Clearly, Wallerstein's theory of world system emphasizes solely the economic dimension. World system theory recognized that all national economies are part of a worldwide division of labor and stressed the asymmetric character of the exchange relations existing between developed and developing nations, which are said to benefit the former (Wallerstein, 1974). Simply put, the European world-economy is an economic rather than a political entity.

Wallerstein further suggests that the techniques of modern capitalism and technology of modern science enabled this world-economy to thrive, produce, and expand without the emergence of a unified political structure. However, technological improvement, including transportation and communication, is not a critical factor because China had about the same level of technological development as European countries had in the sixteenth century, but it

never emerged as a world economic system. Moreover, each single and vast political regime such as China, Persia, and Rome were never free from political crises compared to Western small city-states, nation-states, or small empires.

According to Wallerstein, capitalism as an economic mode is based on the fact that the economic factors operate within an arena larger than that which any political entity can totally control; namely, capitalism is the political side of the form of economic organization. Following Marx's conceptualization of profit and applying it to nation-states, Wallerstein sees national capital accumulation as the ability to accumulate labor-produced value over and above population needs of the nation, or more simply, to maintain favorable balance of trade (Irwin and Kasarda 1994). Although Wallerstein insists on capitalism as the single dimension which is responsible for modern transformation, the profound influence of a broader connection between structural position in external transaction networks and internal structure within the world system is quite obvious.

Dependency theory also focuses on the unequal exchange between nations. Yet, dependency theorists recognize the international class structure and also take simply capitalism and international trade as the key factors. Its main contributions are to distinguish development as a continuous concept and to point out the dynamic

relationship within the world stratification structure over time. Nevertheless, this approach fails to interpret the rationalities for stable positions or stagnation of upward mobility within the semi-peripheral and peripheral areas. Using Canada and Mexico as examples, both have been characterized as having "dependent development" on the U.S. economy, while one is usually grouped in the core and the other is in the periphery (Chirot and Hall 1982; Glenday 1989; Resnick 1989). In other words, dependency theorists made a valuable contribution to our understanding of the way the world is, but they were weak on explaining why it is that way (Weaver and Berger, 1984).

The other criticism is from its failure to explain why political independence did not lead to development for many Third World countries in the post-colonial period. Therefore, the so-called nondependency Marxist theory of development, one of the major variants within dependency theory, claims that the problems of poverty and underdevelopment in the Third World are largely internal and that their solution are internal. In general, dependency theory may fall into a trap of mechanistic oversimplification, assuming that the less-developed countries are developing and that their internal problems will resolve themselves. One final note is that both world-system and dependency theory are developed from a regional base, European countries and Latin America, respectively.

As Evans and Stephens (1988) postulate, as long as the range of cases being compared remains so restricted, claims to the establishment of general explanatory relations must be considered fragile. Only by studying very different world-systems can we formulate a theory of structural transformation (Chase-Dunn and Hall, 1993).

Previous Network Studies

Snyder and Kick's (1979) article was the first explicit attempt to use the social-network approach to examine the world system. By using a "blockmodeling" technique with CONCOR algorithm, Snyder and Kick's comprehensive research design set the standard for later studies. Breiger (1981) explains this concept in reference to the network of countries:

> "[A] blockmodeling approach to international trade assigns status to positions according to [the] structural similarity of the nation's imports and exports to all other states, across types of economic exchange." (1981, p.357).

Examining data on international exchanges around 1965, Snyder and Kick argued that their results provide quantitative evidence for Wallerstein's model of a tripartite division of nations into core, periphery, and semiperiphery. Although their regression analysis supported the world-system model, Jackman (1980) criticized the basic

variables employed in their model as badly skewed, so that the estimated disturbance is likely to be heteroscedastic.

Steiber (1979) made a similar attempt to establish an appropriate methodology for world-systems analysis. Nevertheless, the results were either much more modest (Smith and White 1992) or the structural equivalence of countries in terms of their trade patterns is highly confounded with geography using CONCOR-like factor analysis (Schott 1986). Snyder and Kick's model was later elaborated by Nemeth and Smith's (1985) follow-up study which attempts to formulate a better blocking of international system structure. Their utilization of the data on the value of different types of commodity exchange allows them to directly access the roles that importing and exporting countries play in the global division of labor. However, the results of this approach did not improve much over those of Snyder and Kick. The only differences are the classification of certain countries into world-system roles and in the overall layered image of the international system which followed.

Smith and White's (1992) recent studies using refinements in network analytic techniques (blockmodeling with REGE algorithm) with concentration in the network of international trade flows, which allows a more precise operationalization of role equivalence, further suggests that social-network analysis could be usefully employed in

studies of international relationships between countries. However, they narrow the scope and content of analysis and simply attempt to rank observations (strata of countries) by the relevant concepts suggested by world system theory. Besides, the relatively important roles played by correlated economic exchange networks and other socio-political indicators influencing economic growth were clearly left out. As London and Williams (1988) point out, research using merely world system theory have, by and large, concentrated exclusively on a state's position in the world economy. In addition, Chirot (1981) notes that dependency and world-system theorists shifted the focus of analysis away from the study of "modernization" and toward the study of "international power relations."

Implications of Centrality Measures

Two major programs have been used in applying blockmodeling technique for measuring structural positions of observations in a network. CONCOR algorithm, as one of two alternative bases for measuring positional proximity, were constructed to evaluate matrices of binary data; that is, either an interaction is present or not. However, transactions in spatial systems are usually measured by the magnitude and volume of interactions, since virtually all places have some degree of economic, information, or personnel exchange with all other places in the network

(Irwin and Hughes, 1992). Furthermore, Schweizer (1988) has shown in empirical examples how CONCOR algorithm conflates spatial proximity with global role structure. While the other method, REGE algorithm, can identify the more generic structural positions in a network, it may result in a significant loss of information due to the crude processes of blocking or clustering of actors and modest description of aggregate relations between the positions of blocks within strata of the world system.

Network analysis with centrality measures which have been notably applied in urban structural theory are suggested to be an appropriate measure in exploring global economic structure (Irwin and Kasarda 1991; Irwin and Hughes 1992; Irwin and Kasarda 1994; Meyer 1986; Ross 1982; Ross 1987). Concepts of position in spatial interaction networks are pivotal to all theories of urban structure (Irwin and Hughes 1992). Notions such as "centrality" "dominance" and "hierarchy" have been important issues in the literature of human ecology since the early 1930's. A primary assumption of most urban systems research is that the location of the metropolis in a nationwide division of labor indicates its dominance or subordinate status within one or more of the levels of the typology (Kasarda 1974). Its applicability to the worldwide division of labor has also been widely recognized by world system analysts (Castells 1985; Meyer 1986). Irwin and Hughes (1992), argue

that concepts of structural position in external transaction networks are emerging as a central theoretical issue across all socio-spatial approaches.

From at least three aspects, centrality measures are more exceptional than blockmodeling in network analysis of global structure. First of all, conceptualization of point centrality considers two interrelated issues: (1) content of transactions, and (2) the scope of interaction implied by the transaction, since the interactions affecting position vary greatly in content and scope (Irwin and Hughes 1992). Hence,

> "The scope and content of the interaction influence the assumed positional effect of other vertices. With a limited scope of interaction and immediately deteriorating content, point centrality is determined by direct ties; only dyadic interactions affect network position. In the case of a more extensive scope, and a content that does not diminish with a direct transaction, the position of other vertices affect the centrality of a given point." (Irwin and Hughes 1992, p.19).

Three conceptualizations of point centrality - closeness-based, degree-based, and competitive distance - will be applied to the multiple-network analysis of transactional interactions in the structure of global economy. The closeness-based conceptualization which implies a broader scope of interaction is assumed to superiorly apprehend the effects of internationalization of markets for labor, capital, and commodity trades. Closeness centrality stresses the importance of both direct

and indirect access to all other vertices in the network. In addition, this view takes the relative position of other vertices into account (Irwin and Hughes 1992). Irwin and Kasarda's (1991) research on "Air Passenger Linkages and Employment Growth" provides a good example of such effects. On the other hand, degree-based conceptualization views network position as a function of direct interaction among vertices. It can be utilized as a measure of comparison with closeness centrality and evaluates their relative construction validities. The conception of competitive distance can best be seen in depicting the key term "dependency" for the political economy perspectives[3]. Furthermore, the formation of regional strata or blocks of transactional networks can also be better pictured. Unlike previous network analysis, measures of network were circumscribed to the sole application of directed graph theory that interaction has an effect simply on network position independent of the effects of other characteristics.

Besides the advantage of evoking a different view of network position, centrality scores as continuous measures are more convenient for conceptual interpretations and more

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[3]Using 1990's international trade flow data as the most obvious example, the status of "dependent development" of Canada in the world economic system is clearly captured by the conceptualization of competitive-distance centrality measures. Canada's centrality scores in the network of trade flows of 1990 for closeness, degree, and competitive distance are 1.365, 0.627, and -.446, respectively.

accessible for statistical applications. On the other hand, research measuring countrys' structural position in the world system using blockmodels have difficulties translating results into a meaningful ordered association with a tripartite model or models with a few more strata[4]. Additionally, when applying the blockmodel analysis of networks into statistical models, the coarse clustering process causes these variables to be badly skewed. Following Snyder and Kick's (1979) argument, we can refer blockmodel and centrality analysis of networks to the measures of "position" and "dominance." This approach conceptualizes position as a discrete location in the world system and dominance as one possible form of structural relations among positions or actors. However, note that measures based upon these centrality conceptions do not necessarily evaluate the efficacy of different theories; instead they illuminate different aspects of network structure (Irwin and Hughes 1992).

A Multiple-Network analysis

Previous network analysis was focused heavily on the articulation of political economy perspectives. Hence, the

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[4]Wallerstein's model of a tripartite division of nations into core, periphery, and semiperiphery has been generally rejected by empirical research utilizing network approach analysis. For example, Snyder and Kick (1979) developed a 10-block partition model; Smith and White (1992) identified two more subblocks for the peripheries and semiperipheries.

study of interdependence or integration among international communities is often neglected. Four types of international networks have been employed: trade flows, military interventions, diplomatic relations, and conjoint treaty memberships. However, only trade flows consistently contribute to the analysis. On the other hand, a variety of transactional networks has been employed by ecologists emphasizing the increased interdependence of the economies of nations. Pivotal transactional flows are suggested from the studies of control and coordination (banking and corporate offices) and physical (commodities and passengers) linkages in the United States or regional international communities (Bochert 1972; Conzen 1977; Duncan and Lieberson 1970; Filani 1973; Irwin and Kasarda 1991; Irwin and Hughes 1992; Meyer 1986; Pappenfort 1959; Pred 1977; Taaffe 1962). This research operationally defines the internationalized global structure using three dimensions of international networks: trade flows, capital dominance, and labor flows. While these three networks obviously cannot exhaust various types of interactional contact, each of them do capture a substantively important aspect of transactional interactions.

International trade flows have been included virtually in every empirical research of world system analysis (Delacroix 1977; Firebaugh & Bullock 1987; Nemeth and Smith 1985; Smith and White 1992; Snyder and Kick 1979; Steiber

1979; Stokes & Jaffee 1982). It is the principal assertion held by most political-economy theorists that through international trade core nations seize advantages from various forms of unequal exchange and then maintain the status quo in the international economy. Also, trade-flow networks among core nations are much denser than those with the other two "subordinate" strata, regardless of types of commodities. On the other hand, diffusionist theorists contend that while upward mobility from peripheral or semiperipheral to core nations is considered to be infrequent by political-economy theorists, integration into the world economy was shown to be beneficial for less-developed nations (Firebaugh 1992; Firebaugh and Beck 1994). Disagreement can also be found from the horizontal dimension of internationalization. While diffusionist perspectives assert the comparative advantage from the approach of international division of labor, political economy theorists claim that the core creates and manipulates economic developments in the periphery (Amin 1976; Castells 1984; Frank 1967; Hopkins 1982).

The network of capital dominance is measured using assets holdings of multinational and consortia banks among countries. Ecologists argue that international financial linkages are a pivotal key function that exerts dominance in intercommunity transactions. Meyer's (1986) research using financial network data (international bank

headquarters-branch office link) confirms that the world system of cities is organized independently of national or world regional boundaries. However, Meyer's analysis focuses on the role of international finance in South America nations and linkages between core metropolises and national metropolises of South America. The present research expands Meyer's analysis using data that encompass a broader network of international financial linkages.

A network of labor flows is employed as another essential dimension that contributes to the trend of internationalization. Hollifield (1992) points out that state's policies towards immigration is a test of political and economic liberalism, and an indicator in the process of globalization. Hence, state's policy may reflect in their market's orientation (labor, capital, and commodity), especially labor flows. This is probably one of the few spheres where the state can show its sovereignty over multinational corporations (MNCs) within the world economy. Consequently, relations between foreign workers and development policies will remain a prominent feature of the international political economy.

Research issues regarding economic development and international migration have been developing toward convergence that labor exchanges will generate beneficial effects for both sending and receiving countries in the long run from arguments of diffusionist perspective as well

as Marxist theory (Jasso and Bosenzweig 1990; Massey et al. 1987; Massey 1988; Piore 1979; Portes and Benton 1984; Tienda and Wilson 1992; Brinley Thomas 1954; Dorothy Thomas 1941; Wilson 1988). Still, debates remain diverse for topics related to uses of immigrant labor, immigrant social and cultural adaption, and labor relations (Bergquist 1984; Deyo 1986; and Fröbel, Heinrich, and Kreye 1981; Portes and Walton 1981). This research is focused on examining the correlations between network exchange of labor flows and economic growth. The argument is that the growing economic interdependence at the international level spurs movements of labor, as well as trade and investment. Differently put, increasing flows of labor may well serve as indicators of economic growth (Abowd and Freeman 1991). Aside from other ingredients, such as capital, cultural, technological and institutional, economic growth does rely heavily on the cycle of international labor movement.

However, due to the incompleteness of data on flows of foreign workers between countries, population by nationality is employed as a proxy. Hence, the effect of labor flows from exchange networks of foreign worker may be mingled with the ethnic division of labor within countries. In this instance, however, the development of ethnic enclaves may well denote the articulation of internal and external (national and global) division of labor. Additionally, the formation of ethnic enclaves is

correlated with and determined by extents of production such as trade, capital, and investment. In other words, the ethnic division of labor is shaped and directed by factors including exports to the world-economy, and direct foreign investment from the multinational corporations. As Lubeck and Palmer (1990) suggest policies toward ethnic diversity and multiethnic states are crucial for achieving upward mobility within the global division of labor - the capitalist world-economy.

Competing Indicators of economic development

As mentioned earlier, measures of economic development can be confounded by "indexing" problems. The problem is caused by the lack of consensus on the definition of economic development. Therefore, this research employs three measures of economic development as dependent variables: growth rate of GNP per capita, the physical quality of life index (PQLI), and Human Development Index (HDI). The purpose of contrasting these measures is to test if growth rate of GNP per capita implies broader theoretical claims. Rationales for choosing these variables are stated as below.

The most commonly used macroeconomic indicators should be gross national product per capita and its growth rate. While criticized for failing to take into account the distribution of economic benefits and to reflect the depth

and extent of economic and social ills, such as poverty, malnutrition, illiteracy, and generally low levels of living, including limited personal freedom and security, many economists believe that GNP per capita, expressed in monetary terms, appropriately adjusted, not only provides reliable comparative measures of relative economic performance, but also serves as an adequate proxy for the non-economic components of development - health, education, living conditions, and the like (Todaro 1992).

An alternative approach commonly referred to as "social indicators" has been developing over the past few decades. This approach consists of efforts to create a reliable composite index of basic needs satisfaction, and to refine the discontent and problems with GNP-related measures (Adelman and Morris 1967; Cutright and Adams 1984; Dixon 1984; Larson and Wilford 1979; Morris 1979; Estes 1984; UNDP 1990; UNRISD 1970). Within these various indices, the constructions went to both extremes; for example, Estes' INSP consists of 41 indicators, including such diverse factors as women's status, political stability, and "defense effort," while Morris' PQLI scale, at the other extreme, consists of only three items: infant mortality, life expectancy, and literacy. Even though criticized as being ad hoc and taking the advantage of measurement convenience, Morris' PQLI scale has been widely used (Inkeles 1993), and has the advantage that it is less

sensitive than most measures of basic needs to differences among countries in customs, economic organization, and climate (Morris 1984).

The UN development program's HDI scale provides a much needed and highly informative complement to the more widely known but more narrowly conceived (because of its strictly economic orientation) annual World Development Report published by the World Bank (Todaro, 1992). The most serious criticism of this scale so far is that it fails to include systematic information on, and an analysis of, political freedoms and human rights (Kelley 1991). Since these two factors are less related to economic growth, HDI scale holds superior assessment to serve as a valid model for the present research.

Alternative determinants of economic growth

Four groups of alternative hypothesized determinants of economic growth (dependence, industrialization, human capital investment, and military power) are introduced in the multiple regression analysis to assess the relative effects of network centrality in determining national economic growth. Each group of alternative determinants captures principal conceptions from competing theories of economic development discussed in the beginning of this chapter.

Investment dependence is the key term in the reflection of the Third World's persistent peripheral status, and it acts as the thrust of dependency theorists. Direct foreign investment (DFI, or transactional corporate investment (TNC)) is employed and considered to be a preferable indicator in the measurement of "dependence." Among the factors that explain economic growth in developing countries, capital penetration has been commonly characterized by scholars as a controversial factor leading countries to prosperity or persistent underdevelopment. Political economy theorists such as Wood (1986), still make a compelling argument that the "concessional financing" offered to the Third World as loans and aid has become a major mechanism of dependence in the second half of the twentieth century. Wood postulates that even the "softest" forms of concessional financing restrict the development choices possible for poor nations by enhancing the leverage available to the rich ones.

Conversely, theorists of diffusion perspectives argue that international investment is a critical catalyst leading countries to achieve economic development (Firebaugh 1992). Bias due to inadequate measurements in cross-national analysis is the major difficulty facing dependency research. As a result, foreign investment is concluded as having harmful long-term effect on economic growth. Therefore, it is essential to include direct

foreign investment as alternative determinant in the regression model to examine its effects on economic growth relative to international networks.

Writers from the world-system perspective have also emphasized that pivotal role of trade in the international division of labor. Through unbalanced trade relationships, core nations accumulate labor-produced surplus value within the world economic system. Thus the dominance pattern of core and periphery are steadily formed. This viewpoint, while incorporating tarde as external element to political systems in their analysis, posits that trade remains internal to the capitalist world system. Hence, the effects of trade networks as external elements are examined relative to internal structure. Primary export dependence and export intensity are employed to test the internal path between "dependence" and economic growth.

Industrialization has also been depicted as a channel of reproduction of hierarchy of the world-economy. World-system and dependency theorists argue that ties of dependence between developed and less developed areas produced and now perpetuate a core-periphery division of labor (Wimberley and Bello 1992). In other words, core nations have employed these economic goals and structural means to pressure political and economic actors of the periphery and semiperiphery throwing themselves into the illusion of "industrialization." Similar arguments are made

by theorists of diffusionist perspectives, however, with a positive and optimistic tone. Consequently, labor intensity (percent of labor in industry) and capital intensity (percent of GDP from industry) as indicators of industrialization are included in the regression models.

World military order is emphasized as one of the most important dimensions of globalization. In specifying its nature, Giddens (1990) states that we have to analyze the connections between the industrialization of war, the flow of weaponry and techniques of military organization from some parts of the world to others, and the alliances which states build with one another. It is assumed that the consequence of nations in the "Economic Third World" may partly result from their high expenses in building a "First World" in respect to weaponry. From the perspective of the "First World," Goldfrank (1983) contends that military investment has the short-run logic of protecting foreign investments and world stability on the one hand, while aiding sluggish domestic heavy industries. Nevertheless, Kaldor (1981) questions the long-run consequences of weapons refinements. In general, Webster (1989) found that military expenditure is an important indicator of economic growth.

Additionally, human capital investment is emphasized by both diffusionist and political economy perspectives (Barro and Becker 1989; Firebaugh and Beck 1994; Lucas

1988; Nemeth and Smith 1985; Romer 1990; Snyder and Kick 1979; Wimberley and Bello 1992). Underinvestment in education, research, and development combined with overinvestment in the military sector is considered an essential feature of hegemonic decline (Goldfrank 1983). Despite being a conventional determinant, education has been consistently stressed as a critical factor virtually in every development research. The significance of education is revitalized especially when the case of Japan and the newly industrializing countries (NICs) of East Asia and Latin American have been cited to support the call for a human resource development strategy. Since the international diffusion of a pro-development ideology led nations to expand schools and school enrollments during the 1950-1970 period (Meyer et al. 1979), secondary school enrollment ratio is often used to replace primary schooling as the indicator measuring economic growth.

Dynamics of the World System

Political economy theorists recognize that nations may shift among core, semiperiphery, and periphery (Wallerstein 1974), but the dominant pattern since the mid-nineteenth century shows a relative stability of the core-periphery grouping (Amin 1976; Bergsen and Schoenberg 1980; Frank 1967). In other words, this change in rank of positions in the world system is considered to be infrequent.

Conversely, diffusionist perspective theorists argue that it is likely that countries in the semi-periphery or periphery will achieve upward mobility in the world stratification.

The other issue of dynamics concerns the result of competition among core nations. Historically speaking, the cycle of competition among core nations has swung between a hegemonic or multicentric structure of the world system during the period 1945-1965 (Bergesen and Schoenberg 1980; Chase-Dunn 1982, 1984). After that period, hegemonic domination has been transitory, leading to a predictable pattern of economic and political decline for the hegemone (Goldfrank 1983; Wallerstein 1974). The present research is seeking to explore the development path from three time points, 1970, 1978, and 1990.

CHAPTER THREE

THEORETICAL FORMULATION AND RESEARCH HYPOTHESES

Theoretical Framework

One major concern of this research is the alignment of conventional development theory with network conception in ecological theory. After reviewing the literature of approaches to the world economy, Irwin and Kasarda (1994) contend that while this network conception has always been an explicit theoretical basis of ecological theory, all current approaches, such as regional economics, central place theories and dependency approaches, are incorporating this network view. Meyer's (1986) research on relations between international financial metropolises and South American cities was probably the first attempt to converge the dependence/world-system theory and ecological paradigm. Though, methodologically, the network linkage between international bank headquarter and branch office are recorded in binary form rather than continuous flows, the study provides important clues about the integration of the world system of cities.

The present research is also an attempt to fill in the empirical lacuna of theories of development. This task is expected to be performed by applying major conceptions, such as hierarchy, dominance, and interdependence from ecological theory and centrality measures of network

approach. As Meyer (1986) points out, although hierarchy, dominance, and specialization are ecological principles, these have not been emphasized in empirical research by ecologists or modernization theorists. On the other hand, neither modernization nor ecological approaches have taken international linkages and processes into account (Kasarda and Crenshaw 1991). Additionally, by studying only developed nations, ecologists have not been confronted with the economic gaps which exist at the world scale (Meyer, 1986). Hence, research interest is focused on extending major ecological concepts to the world scale, as well as their conjunction with development literature employing a multiple-network analysis.

Based on the review of development literature in the previous chapter, we can find that there is very little consensus among proponents of each perspective, or even within variants of conceptualizations. This research is centered on some of the fundamental disputes over theoretical assumptions.

The basic assumption underlying this approach is that the world economy system should be examined through external relations relative to internal structure. Arguments of both political economy and diffusionist perspectives are essentially internal views. Starting from different, or opposite premises, modernization and dependence/world-system theories agree on the internal view

of structure of world economy. While most dependence/world system theorists follow Marx's conceptualization of profit and assert that interactional transactions are primarily endogenously generated from the relations of production within society, the focus of empirical analysis has been shifted to a more relational view of international exchange (Nemeth and Smith 1985; Smith and Nemeth 1988; Smith and White 1992).

Clearly, the internal view of system structure has been empirically or theoretical challenged by research that came to emphasize the important concepts of structural position in external transaction networks. Accordingly, this external orientation should be adopted by the present research. I assume that integration into the international community is necessary for economic growth. The combined forces of the internationalized markets for labor, capital, finance, and commodities are the principal factors which necessitate both changes of global structure and development of national economies.

Another related issue regarding network conceptualizations is the debate over the scope of interaction. Although reconceptualized in network terms, recent economic research maintains that transactions occur between a pair of areas; the resulting network flows are seen as a series of direct transactions among economies. Simply put, the scope of interaction is limited to the

dyad. While theorists of political economy perspectives take into account direct and indirect access to the entire network, they view an area as less central if it is connected to a dominant economy. The assumption underlying this perspective is that more avenues for interaction increase competition among areas and reduce point centrality (Irwin and Hughes 1992). This study proposes an important ecological concept of interdependence upon measures of dominance and subdominance in a system. A country that optimizes direct and indirect access to the entire network occupies a dominant position.

The most controversial argument lies at the international class formation. One of the most striking features of global development has been the remarkable slowness of response between economic growth (development) and change of position (vertical mobility) in the hierarchy of the world-systems. Research interest has focused on testing the general validity of Wallerstein's stratified model of core/semiperiphery/periphery. There is considerable dispute over issues such as (1) the existence of more than three strata, and whether such strata are formed by discrete clusters of countries, or more of a continuum; (2) the distinguishing characteristics of membership in each stratum; and (3) the assignment of particular countries to these strata (Smith and White 1992). However, these discussions are basically static; the

dynamics of the world economy are considered in the present research. Additionally, both the horizontal (interdependence) and vertical (mobility) dimensions of transactional networks instead of static configurations of the world system characterized in terms of relations between countries in the respective blocks or strata are concentrated.

Hypotheses

Based on the preceding literature reviews and conceptual formulations, the following eleven major hypotheses are derived.

Hypothesis 1. A global hierarchy can be identified based on international trade, capital, and labor flows, and such hierarchy is formed as a continuum of roles rather than a stratified model or discrete clusters of countries.

Hypothesis 2. Vertical (upward or downward) mobility for a country is likely to occur in the world economy system.

Hypothesis 3. Network centralization is likely to decline for the entire global networks as well as all geographical regions.

Hypothesis 4. The cycle of competition among core nations is more likely to result in a multicentric rather than hegemonic structure of the world system.

Hypothesis 5. Countries with higher centrality in trade, capital, or labor network are more likely to exhibit increasing economic growth.

Hypothesis 6. Indirect transactional interactions are having positive effects (closeness centrality) for a country's economic performance, in addition to direct transactions (dyadic network flows).

Hypothesis 7. Network centralities are better predictors than alternatively hypothesized determinants on a nation's economy growth.

Hypothesis 8. Growth rate of GNP per capita are superior than PQLI and HDI in measuring a nation's economic performance.

Hypothesis 9. Network centralities have increasingly positive long-term effects on economic growth over two time periods (1970-978, 1978-1990).

CHAPTER FOUR

RESEARCH DESIGN

Units of analysis

Nation-states are the units of analysis for the present research. Although individual cities may be more appropriate than nation-states as units of analysis,[5] data availability has restricted our understanding of international networks and their social and economic implications. Most of the important economic flows are only available on a country-to-country basis. Besides, it is hardly controversial to specify nation-states as the most important actors in the modern world system (Wallerstein 1974; Chirot 1977).

A variety of units of analysis have also been employed in previous research. However, each provides only a partial conception of the global economic network. There is a basic consensus among world-system analysts that the world economies should be the basic unit of analysis. Snyder and Kick (1979) used four matrices of international relationships: trade, military interventions, treaty

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[5]As Irwin and Kasarda (1994) claim, mainstream economists are no longer taking national boundaries as unequivocal spatial units, focusing instead upon interactions between flows of products and flows of production factors as two processes creating economic integration of areas. For these reasons, it would seem appropriate to concentrate on individual cities and their networks rather than on nation-states as units of analysis (Evans and Stephens 1988; Kasarda and Crenshaw 1991).

membership, and diplomatic exchanges. The unit of analysis of Meyer's (1986) article is the international bank headquarters -- branch office link. Nemeth and Smith (1985) focus exclusively on flows of types of international commodity trade. This approach was derived in order to place greater emphasis on the economic base of the world-systems' structure.

Data and Variables

Since the principle objective of the present research is to study the effect of global integration on stratification of the world system and economic growth on an international basis, no specific restrictions, except for data availability, are applied to exclude any country from this research. That is, only nations for which data for one or more variables are missing are excluded from regression models. As a result, the sample consists of 93 and 72 countries for network analyses and regression models, respectively. Countries included in the regression analyses are comparable with respect to population size and GNP per capita,[6] which are considered basic measures of a country's economic scale.

Countries are also classified into six regions, in order for the measurements of network centralization. This

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[6]Only Iceland, Cyprus, and Malta have population size smaller than one million; however, their GNP per capita are all greater than six thousand.

classification is based not on cultural realm but on a global spatial economic framework. These six geographic regions are identified as North and Latin America, the Asian Pacific and South Asia, Western Europe, Eastern Europe, sub-Saharan Africa, and North Africa and Southwest Asia.[7] Countries included in this research are provided in Appendix C.

Table 1 provides a brief description of the variables and data sources used to construct these variables. With respect to distinctive analyses, the following discussion of variables is organized into three sections: measures of network matrices, economic growth, and alternative determinants of economic growth.

Network Matrices

Trade Flows. Information on the international trade flows of 93 countries is derived from the International Monetary Fund's (IMF) Direction of Trade. Total value of trade is assessed. The IMF's Direction of Trade is complied annually and contains matrix-type information on import and export data. Import data will be used since they are believed to be more accurate than export figures (see Durand 1953; Linnemann 1966; Smith and White 1992). Total values of

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[7]De Blij and Muller (1992) suggest that the identification of North Africa/Southwest Asia region reflects powerful influences of its religion (the Islamic realm), culture (the Arab world), and geography (the dry world) complexity.

Table 1. Definition of Variables and Data Source

Variable	Definition	Source
I. Centrality Measures		
Trade Flows*	Level of Trade Centrality for a Country	Direction of Trade, International Monetary Fund (1990) Direction of Trade, ICPSR 7628 (1970, 1978)
Capital Dominance	Assets Holdings of Multinational and Consortia Banks Between Countries	World Banking (1970, 1978)
Labor Movements	Nationality of Foreign Worker	International Data Base, U.S. Dept. of Commerce, Bureau of the Census, Center for the International Research (1970, 1978)
II. Other Measures of Economic Growth		
Capital Penetration	Direct Foreign Investment (DFI) Relative to GDP	World Tables of Economic and Social Indicators, World Bank (1970, 1978, 1990)
Primary Export Dependence	Value of Nonfuel Primary Exports as a Percentage of Total Merchandise Exports	World Bank, World Tables (1970, 1978, 1990)
Export Intensity	The Size of The Export Sector Relative to National Product	World Bank, World Tables (1970, 1978, 1990)
Labor Intensity	Percent of Labor in Industry	World Bank, World Development Report (1978, 1990) World Handbook of Political and Social Indicators, Vol. 1 (ICPSR 7761, 1970)
Capital Intensity	Percent of GDP from Industry	World Bank, World Development Report (1978, 1990) World Handbook of Political and Social Indicators, Vol. 1 (ICPSR 7761, 1970)
Defense Expenditure	Military Expenditure as a percentage of GNP	Human Development Report, United Nations (1978, 1990) World Handbook of Political and Social Indicators, Vol. 2 (ICPSR 7761, 1970)
Human Capital Investment	Secondary School Enrollment As a Percentage of the Secondary-School-Aged Population	UNESCO, Statistical Yearbook (1970, 1978, 1990)

* Data for Taiwan were from Bureau of International Trade, Taipei, Taiwan, R.O.C.

(table con'd.)

Variable	Definition	Source
III. Indicators of Economic Growth		
Economic Growth Rate	Logged Differences of GNP per capita	World Bank, World Development Report (1970, 1978, 1990)
The Physical Quality of Life Index (PQLI)	- Infant Mortality Rate - Life Expectancy at Birth - Literacy Rate	Morris (1979)
Human Development Index (HDI)	- Life Expectancy at Birth - Adult Literacy and Mean Years of Schooling - Income (measured by per capita GDP adjusted through a complex formula for purchasing power parity)	U.N. Development Programme. Human Development Report (1990)

trade are reported by their value in U.S. dollars. Although the information in this dataset is surprisingly complete, the information on Taiwan was excluded since that country was replaced by China in the United Nations in 1971. However, data on trade statistics since that time are constructed in the exact same format as those of the UN by the Bureau of International Trades (monthly Statistics of Exports and Imports), Taipei, Taiwan, Republic of China.

Capital Flows. This network is measuring the international financial structure and degree of linkages. The variable is identified by assets holdings of multinational and consortia banks among countries. The source of data is from World Banking. The data are collected by first identifying the headquarter country of every multinational and consortia bank with assets holding from at least one other country. Then, assets holding of each country is transformed and recorded in millions of U.S. dollars. The source and formula in calculating exchange rates are based on the World Bank's annual average exchange rate in 1970 and 1978. Eventually, a matrix of capital relations between each pair of nations is constructed.

Labor Flows. The International Data Base contains data on foreign workers by country of origin. However, the information is extremely incomplete. For this reason, population by ethnic origin is employed instead. This data

set is a release of ICPSR (8490), conducted by U.S. Dept of Commerce, Bureau of the Census, Center for International Research. Data are organized as a series of statistical tables identified by country and table number. This exchange network is constructed from Table 83.

Measures of Economic Growth

Economic growth rate. The analysis of growth rates has been central to much comparative research, however, a methodological problem is still common for many research designs. The first-difference design simply defines growth as the difference between two time periods, $Y_t - Y_1$, where t and 1 refer to the later and initial time periods. However, problems arise when Y_t and Y_1 are as badly skewed as they often are, especially (but not exclusively) in cross-national research (Jackman 1980). Percentage change, defined as $100(Y_t - Y_1)/Y_1$, is also a simple rate measure. A percentage change does not take into account the length of the time interval, however, so the annual rate of change - defined as [t^{th} root of Y_t/Y_1] - 1 where t is measured in years - is often used instead (Firebaugh and Beck 1994).

I adopt Firebaugh and Beck's (1994) difference-of-logs model for the measures of growth rate. As Firebaugh and Beck explain, because $\log(Y_2) - \log(Y_1) = \log(Y_2/Y_1)$, and $\log(Y_2/Y_1)$ measures the growth rate of Y, the difference-

of-log model is a growth-rate model.[8] Hence, the methodological problems mentioned above can be differenced out, as well as bias due to omitted variables.

The Physical Quality of Life Index (PQLI). This composite index is an effort made by Morris David Morris (1979). Most measures of economic growth applying basic needs approaches are either focused on material needs or somewhat concentrated on a core of items such as critical foods and shelter (Morris 1984). Morris has developed an index that is based on outputs rather than inputs. It combines life expectancy, infant mortality, and literacy.

Human Development Index (HDI). HDI is the most recent effort made by the United Nations Development Program (UNDP). This index contains three key goals of development. These goals are longevity as measured by life expectancy at birth; knowledge as measured by two educational stock variables (adult literacy and mean years of schooling); and income as measured by per capita GDP adjusted through a complex formula for purchasing power parity. The adjustment

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[8]Economic growth is also measured as the average annual percentage growth rate of GNP per capita from 1970-1978, and 1978-1990, with GNP per capita measured as described below, but not logged. This rate is computed by (1) taking the geometric mean of the ratios of (a) GNP per capita for each year from 1965-1980, and 1980-1990 to (b) GNP per capita for the previous year, (2) subtracting 1, and (3) multiplying by 100. As Firebaugh and Beck suggest, an annual growth rate is virtually equivalent to the difference-of-logs measure ($r > .999$ between the two measures for the variables used in this analysis) for cross-national data.

reflects a critical assumption of rapidly diminishing utility returns to higher income levels (Todaro 1992).

Predictor Variables of Economic Growth

Four groups of alternative determinants of economic growth which have been most commonly employed in comparative research on effects of global economic growth are included in multiple regression models, relative to network measures of growth. These variables reflect major theoretical and empirical significance within the rapidly growing development literature. Four principal dimensions are postulated: dependence (capital penetration, primary export dependence, and export intensity), level of industrialization (labor intensity or capital intensity), human capital investment, and world military order. Note that in preventing similar methodological problems facing the dependent variables, all the alternative determinants of economic growth are logged to attain the model's overall consistency.

Capital Penetration. The most adequate measure of the degree of penetration by multinational capital is developed by Ballmer-Cao and Scheiddiger (1979) and later published in Bornschier and Chase-Dunn (1985). The measure is often termed PEN, which is based on the total stock of direct foreign investment in relation to total energy consumption and population. However, the measure is available only for

1967. Another similar measure derived by Muller (1988) is employed instead. The variable is measured by total amount of direct foreign investment (in million U.S. dollars) in relation to GDP [(DFI/GDP) x 100]. In achieving log transformations for the overall model,[9] this negatively-skewed variable requires an approximately symmetric distribution which is accomplished with an exponential transformation.[10] The data are from World Bank, World Tables of Economic and Social Indicators.

Primary Export Dependence. Primary export dependence is measured as the value of nonfuel primary (or unprocessed goods) exports as a percentage of total merchandise exports for three time periods. Data are from World Bank, World Tables. Since this variable has a potential minimal value of 0, which violates the argument of logarithmic transformation, .01 is added prior to the transformation. Similar procedures are applied to all other variables in this study having the same standing.

Export Intensity. Economic growth may be affected not only by primary export dependence but also by export intensity: the size of the export sector relative to national product

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[9]For base 10 logarithm, the argument has to be greater than 0. All logs used in this research are common logarithms.

[10]The transformation is $2^{X/10}$, where X is the percentage of direct foreign investment relative to GDP and 10 is a scaling factor. Similar transformations are performed for the other variables which contain negative values.

(cf. Bollen and Appold 1993). Export intensity is measured as the value of all merchandise exports as a percentage of gross domestic product. Data for total merchandise exports are from the World Bank, World Tables. Data for gross domestic product are from World Bank, World Development Report.

Labor Intensity. This variable is measured by the number in the labor force for industry as a percentage of the number in the total labor force. Industrial activities include mining and quarrying, manufacturing, construction, and public utilities. For 1978 and 1990, these are direct measures from World Bank, World Development Report. For 1970, data are from Taylor and Jodice's (1983a) World Handbook of Political and Social Indicators (ICPSR 7761).

Capital Intensity. Data for this variable are from the same sources as those for labor intensity. The variable is measured by the contribution of the industrial sector to total gross domestic product at current factor cost. The industrial sector includes manufacturing, mining, construction, and electricity, gas, and water.

Human Capital Investment. Enrollment estimates for primary and secondary school have been available for virtually all countries since the mid-1960s. However, Firebaugh and Beck (1994) suggest that primary schooling became nearly universal in many less developed countries during the years studied here. The problem of ceiling effect may arise if

estimates for primary school enrollment are employed. Hence, this study used secondary enrollment as a percentage of the population of secondary school age children. Data are from UNESCO, Statistical Yearbook.

Defense Expenditure. This variable concerns notions of "the industrialization of war" and the expenses a nation is willing to pay in building a "First World" military defense in respect to weaponry. Hence, the variable is defined as military expenditures as percent of gross national product. For 1978 and 1990, data are from UN, Human Development Report. Data for 1970 are from Taylor and Jodice's (1983b) World Handbook of Political and Social Indicators (ICPSR 7761).

A Conceptual Model

Figure 1 depicts a graphic presentation for the analysis. As illustrated in Figure 1, the first level of analysis is focused on the three international networks using centrality measures. Analysis of the three international networks using centrality measures will allow us to assess the relative dominant position of countries, and patterns of unequal exchange in the world economy (H1 and H2). The question about consequence of competition among core nations can best be answered by measures of network or regional centralization (H3 and H4). Clearly, this approach is superior to Smith and White's (1992)

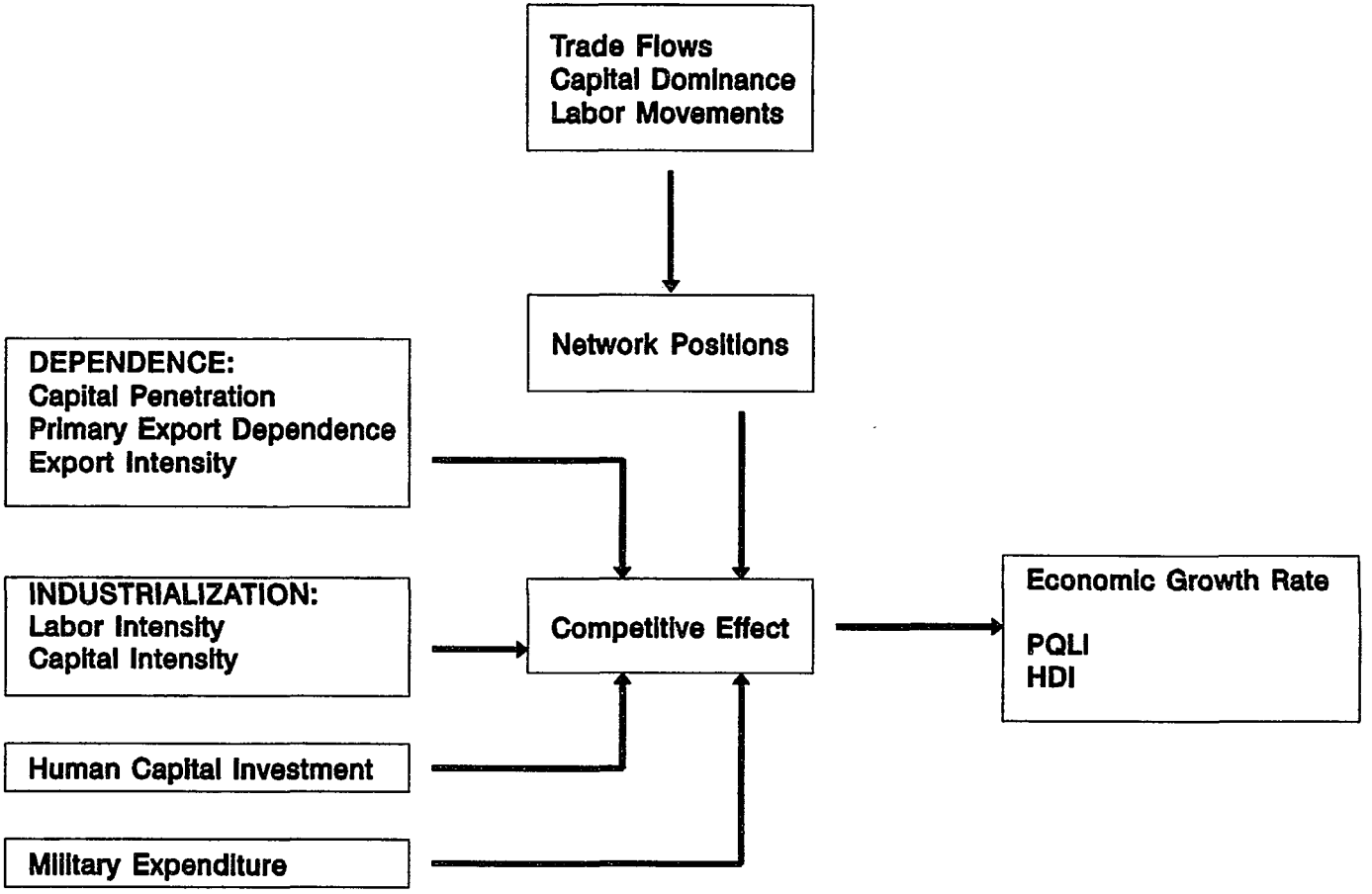

Figure 1. Conceptual Models of Global Economic Growth

strategy by focusing on whether the U.S. was in a unique structural position in the time period 1965-1980.

To further assess the importance of position in the multiple transactional networks as competitive factors affecting global economic growth, multiple regression analyses which contain four groups of alternative variables (three measures of dependence, two measures of industrialization, a measure of defense expenditure, and a measure of human capital investment) are introduced. Rather than estimating cross-sectional or two-wave panel effects, the analysis employed the growth-rate models throughout the research, and for two separate time periods (1970-1978, 1978-1990) to capture the dynamic effects of each measure upon changes in the rate of economic growth (H9).

By comparing the results of regression models, we can estimate the beneficial effects on the recent trend of global integration (H5), both direct and indirect (H6), Besides, the relative validities of competing measures and theories can be examined, as well as the relative significance between network centralities and alternative determinants (H7 and H8).

Measurement

The three international networks are represented by separate N X N matrices. The matrices are all coded as continuous flows rather than in binary forms. Bonacich's

(1987) measure of network centrality are employed to measure the relative dominance of international linkages for all four networks. The general formula for computing centrality, outlined by Bonacich (quoted in Irwin and Hughes 1992, p.25), is:

$$C_i(\alpha,\beta)=\sum_{j}^{n}(\alpha+\beta c_j)R_{ij} \qquad (1)$$

where:
c_i = the centrality score of vertex i.
α = a constant standardizing centrality scores across matrices.
β = the nature and scope of interactions considered.
c_j = the centrality score of vertex j.
R_{ij} = the magnitude of interaction between i and j.

The parameter α standardizes the resultant scores,[11] allowing comparisons across networks of varying sizes, and scales centrality scores such that a value of 1.0 indicates average centrality in a network. The magnitude of the parameter β determines the range of indirect interactions taken into account. As β increases from 0, centrality for any given point increasingly becomes a function of indirect interactions. Values of β may be chosen up to a limit such that the absolute value of β is less than the reciprocal of the largest eigen value of the exchange matrix (Irwin and Kasarda 1991). The three level of conceptions of centrality

[11] α is selected using an iterative routine, written in SAS/IML (version 6).

- degree-based, closeness-based, and competitive distance, are derived by varying the β parameter between -1 and +1. Roughly speaking, $\beta = 0$ denotes degree centrality with direct contacts; $0 < \beta \leq 1$ indicates closeness centrality with increasingly important indirect contacts; $-1 \leq \beta < 0$ determines competitive centrality, measuring harmful effects to central position of a vertex by contacting, either directly or indirectly, to other central vertices. Under this condition, a β value of .8 is used to illustrate a country's network centralities in the world economy. In addition, β values of .8, 0, and -.8 are used to test and contrast the relative validity of theoretical assumptions.

Another measure of network centralization is also utilized based on Freeman's (1979) measure but modified to take account of the standardized centrality scores. Briefly, this measure is a summary statistic indicating the degree to which network flows in the world economy are dominated by a few countries. Network centralization, C, for region R is calculated as:

$$C_R = \frac{\sum_{i=1}^{n} [C_i^*(\alpha,\beta) - C_i(\alpha,\beta)]}{\sqrt{n \times (n-1)}} \qquad (2)$$

where $C_i(\alpha,\beta)$ is the centrality score for country i, $C_i^*(\alpha,\beta)$ is the largest value of $C_i(\alpha,\beta)$ in the network, and n is the number of countries included in the world economy.

The measure ranges from 0 (even distribution throughout the network) to 1.0 (complete domination of network flows by on nation). Regional centralization relative to the international networks and regional centralization relative to all countries within the same region are measured.

The objective of a multiple regression is to estimate the economic consequences of internationalized network flows in the world economy. Moreover, the results allow us to compare and contrast the effects of network and alternative measures of economic growth. A common approach to the explanation of growth rates in cross-national studies employs a first-difference (or two-wave panel) model:

$$Y_t - Y_0 = \alpha + c_1 Y_0 + \beta_{11} X_1 + \ldots + \beta_{1i} X_i + \epsilon, \qquad (3)$$

where t and 0 refer to the later and initial time period, respectively. The model is criticized because of its negligence of the length of the time interval, as well as its extreme vulnerability to badly skewed variables. Jackman (1980) provides a solution to the problems by taking logarithms of the skewed variables. This transformation also takes care the measures of the growth rate of Y ($\log(Y_t/Y_0)$). The model is postulated as:

$$\log Y_t - \log Y_0 = \alpha + c_2 \log Y_0 + \beta_{21} X_1 + \ldots + \beta_{2i} X_i + \epsilon, \qquad (4)$$

Additionally, the model further equips the estimate for Y_0 (c_2) with a substantive rather a technical meaning. The initial value (Y_0) is originally included on the right of the equation to remove the effect of initial score on subsequent gain (i.e., to residualize Y_t - Y_0 by Y_0). Hence, it is difficult to place a substantive interpretation on c_1. Since the measure of the growth rate on the left of the equation has standardized the initial value, any parameters for initial value on the right-hand side can be estimated and interpreted in substantive terms (Jackman 1980).

More recently, Firebaugh and Beck (1994) proposes a difference-of-logs (growth-rate) model with special attention paid to the model's overall coherence. Simple put, all the variables are transformed into logarithms throughout the model. Moreover, the possibilities of floor (initial value) or ceiling effects (e.g., infant survival probability cannot exceed 1.0) usually associated economic measures are taken care. The measure of growth rate can also be employed to reduce the biasing effects of omitted variables.[12] The difference-of-logs form has three advantages: It tends to yield more robust results because

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[12]Examples include a nation's location, topography, climate, rainfall, mineral resources, type and quality of soil, access to seaports, history, culture, economic system, political system, legal system, city system, religious composition, relationship with neighbors, and so on (Firebaugh and Beck 1994).

outliers exert less influence; it avoids out-of-bounds estimates; and its coefficients have a ready interpretation as the effect of one rate on another (Firebaugh and Beck 1994)

The study adopts Firebaugh and Beck's (1994) growth-rate model. The objective is to estimate the effects of transactional interactions on economic growth in the global economy. Hence, aside from three measures of network flows (TRADE, CAPITAL, and LABOR), three measures of dependence (DFI, PED, and EXPORT), two measures of industrialization (LABINT and CAPINT), a measure of defense expenditure (DEFENSE), a measure of investment in human capital (HCI), and a term to capture floor effect (GNP level at time 1) are included to avoid spurious economic effects. Using asterisks to denote logged variables, the basic growth-rate model is:

$$\begin{aligned} GNP_2^* - GNP_1^* = {} & \beta_0 + \beta_1 (DFI_2^* - DFI_1^*) + \beta_2 (PED_2^* - PED_1^*) \\ & + \beta_3 (EXPORT_2^* - EXPORT_1^*) + \beta_4 (LABINT_2^* - LABINT_1^*) \\ & + \beta_5 (CAPINT_2^* - CAPINT_1^*) + \beta_6 (DEFENSE_2^* - DEFENSE_1^*) \\ & + \beta_7 (HCI_2^* - HCI_1^*) + \beta_8 (TRADE_2^* - TRADE_1^*) \\ & + \beta_9 (CAPITAL_2^* - CAPITAL_1^*) + \beta_{10} (LABOR_2^* - LABOR_1^*) \\ & + \beta_{11} (GNP_1^*) + \epsilon, \end{aligned} \tag{5}$$

where GNP refers to one of the three dependent variables (the subscripts "1" and "2" refer to one of the two time intervals: time 1 [1970, 1978] and time 2 [1978, 1990], respectively); DFI is direct foreign investment divided by (or relative to) gross domestic product of a country; PED (primary export dependence) is value of nonfuel primary exports as a percentage of total merchandise exports; EXPORT (export intensity) is the size of the export sector relative to gross national product; LABINT (labor intensity) is percent of labor in industry; CAPINT (capital intensity) is percent of gross domestic product from industry; DEFENSE (defense expenditure) is military expenditure as a percentage of GNP; HCI (human capital investment) is secondary school enrollment as a percentage of the secondary-school-aged population.

Two separate difference models of this form (Equation 5) are examined at the two periods (1970-1978, 1978-1990) for GNP growth rate, for PQLI at first time period, and for HDI at second time period. Hence, a total of four models will be examined in evaluating the relative validity of dependent variables.

Three β parameters (-.8, 0, .8) of centrality measures are analyzed in evaluating the relative importance between network and alternative economic indicators, and in searching for a suitable regression model. The study has also noted the significance of national characteristic in

terms of economic system. Separate growth-rate models are examined for centrally planned economies and oil exporting countries to further explore the generalizability of results. To reassure the economic consequence of global network interactions, reduced-form models are estimated, namely to reestimate the growth-rate models without the network indicators.

CHAPTER FIVE

MULTIPLE NETWORKS AND WORLD ECONOMY

The unique contribution from the application of network approach in studies of intermetropolitan links is its focus on the transaction as a direct measure of the relationship between places. This research further extends the application to international production and product networks by applying a degree-based measure of centrality to these transactional flows. Identifying both the origin and destination of the transaction provides a concrete measure of interactions among countries in the global economy. The centrality scores are interpreted such that countries with higher scores are the pivotal integrators within interdependent international networks rather than being labeled as exploiters to the notion of unequal exchange. Additionally, with centrality score, each country is able to be examined as an individual actor instead of being assigned to particular stratum membership for the analytic purpose of reflecting a typological world-system.

Contrasting Measures of Economic Dominance

The hypothesis that a global hierarchy can be identified based on international trade, capital, and labor flows is supported. Moreover, this global hierarchy is organized as a continuum of roles rather than a stratified

model or discrete clusters of countries. Table 2 describes the relative significance among centrality measures (β=.8),[12] GNP per capita, and a country's position in the world system. Clearly, network approach is a better and more straightforward measure than the others. Centrality scores provide a distinct picture for assessing a country's relative status in the world economy. In addition, applying network analysis, countries with less-diversified trade structure (e.g., oil-producing, and Scandinavian countries), and centrally planned economies are not necessarily excluded from data manipulations. In other words, a great concern toward bias effects caused by different sample composition can be minimized.

On the contrary, despite its simplicity, GNP per capita is a much poorer measure in presenting the relative status among countries. China should be the most obvious example. Looking at its GNP per capita, 130, 220, and 370 for 1970, 1978, and 1990 respectively, it is difficult to picture that China has captured a rapid growth in trade centrality, from .276 to a far greater than average .824. World-system analysts argue that average level of GNP per capita may correspond to world-system status; however, this

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[12]Bonacich has shown that the absolute value of β must be less than the reciprocal of the largest eigenvalue of R (matrix of interaction). Without this limitation β loses its interpretation as a probability and the interpretation of $c(\alpha,\beta)$, as the expected number of paths activated by each transaction, is not valid. This limits the scope of interaction that can be taken into consideration.

Table 2. GNP per capita, Structural Positions, and Centrality Scores Based on Trade Flows, Labor Movements, and Capital Dominance[a]

Nation	GNP per capita 1970	GNP per capita 1978	GNP per capita 1990	GNP Growth Rates[b] 1970-78	GNP Growth Rates[b] 1978-90	Positions in the World System[c] 1970	Positions in the World System[c] 1980	Trade Centrality 1970	Trade Centrality 1978	Trade Centrality 1990	Capital Centrality 1970	Capital Centrality 1978	Labor Centrality 1970	Labor Centrality 1978
United States	4970	10100	21790	.31	.33	1	1	6.240	5.705	5.723	3.723	4.107	6.025	5.466
Canada	3870	9420	20370	.39	.33	1	1	1.426	1.602	1.365	0.645	0.449	1.892	1.534
Japan	1950	7000	25890	.56	.57	1	1	2.879	2.992	3.346	1.303	1.419	0.719	0.506
Belgium-Luxembourg	2670	8760	17560	.52	.30	1	1	1.340	1.428	1.377	2.043	2.734	0.451	0.520
France	2990	8400	19520	.45	.37	1	1	2.380	2.643	2.731	1.923	3.230	2.010	1.920
German, Fed. Rep.	2850	9490	22360	.52	.37	1	1	4.132	4.326	4.552	1.368	1.338	2.959	2.628
Italy	2000	4890	16860	.39	.54	1	1	1.866	1.913	2.200	0.747	0.613	2.838	2.119
Netherlands	2560	8890	17550	.54	.30	1	1	1.479	1.733	1.530	0.464	1.693	0.477	0.548
Switzerland	3480	11690	32230	.53	.44	1	1	0.755	0.751	0.838	1.866	0.742	0.624	0.517
United Kingdom	2220	5200	16060	.37	.49	1	1	2.955	2.563	2.455	7.984	6.899	2.432	2.473
Sweden	4200	10940	23760	.42	.34	2	1	0.866	0.800	0.670	0.379	0.511	0.556	0.559
Australia	3130	8540	16680	.44	.29	2	2	0.567	0.567	0.472	1.024	0.850	0.822	1.009
New Zealand	2190	4930	12310	.35	.40	2	2	0.233	0.137	0.113	0.070	0.113	0.243	0.328
Austria	1960	6870	18980	.54	.44	2	2	0.414	0.479	0.544	0.131	0.150	0.199	0.233
Denmark	3120	10010	22680	.51	.36	2	2	0.482	0.457	0.398	0.181	0.419	0.173	0.129
Finland	2380	7280	24520	.49	.53	2	2	0.654	0.312	0.327	0.265	0.397	0.214	0.212
Ireland	1290	3430	10360	.42	.48	2	2	0.166	0.187	0.247	0.050	0.043	0.181	0.110
Norway	2740	9500	22830	.54	.38	2	2	0.385	0.419	0.379	0.409	0.383	.	.
Spain	1110	3700	11000	.52	.47	2	2	0.434	0.596	0.871	0.055	0.113	1.351	1.166
Hong Kong	900	3750	11490	.62	.49	2	2	0.365	0.434	0.783	0.449	1.515	0.001	0.752
Korea, South	270	1190	5400	.64	.66	2	2	0.150	0.372	0.737	0.050	0.130	0.423	1.087
Nigeria	140	660	290	.67	-.36	2	-	0.131	0.412	0.136	0.050	0.043	0.464	0.781
Yugoslavia	660	2400	3100	.56	.11	2	2	0.317	0.338	0.248	0.056	0.046	0.717	0.671
Argentina	1020	1570	2400	.19	.18	2	2	0.257	0.227	0.128	0.050	0.088	1.070	0.929
Brazil	450	1640	2680	.56	.21	2	2	0.352	0.535	0.406	0.225	0.165	0.810	0.797
Venezuela	1260	3380	2560	.43	-.12	2	2	0.211	0.610	0.157	0.062	0.068	0.702	0.932
Greece	1170	3270	5990	.45	.26	3	2	0.182	0.214	0.186	0.120	0.201	0.580	0.612
Portugal	700	1890	4900	.43	.41	3	3	0.172	0.149	0.262	0.149	0.059	0.904	1.031
Ghana	250	350	390	.15	.05	3	-	0.056	0.044	0.017	0.050	0.043	0.715	0.378
Cote d'Ivoire	270	830	750	.49	-.04	3	-	0.064	0.099	0.041	0.050	0.043	.	.
South Africa	740	1220	2530	.22	.32	3	-	0.329	0.284	0.186	0.064	0.043	0.554	0.599
Zambia	440	500	420	.06	-.08	3	-	0.103	0.034	0.028	0.050	0.043	0.266	0.238
India	110	190	350	.24	.27	3	3	0.279	0.186	0.289	0.050	0.043	2.350	2.426
Malaysia	390	1150	2320	.47	.30	3	3	0.226	0.245	0.364	0.144	0.198	0.566	0.066
Pakistan	170	220	380	.11	.24	3	4	0.110	0.057	0.090	0.050	0.043	2.012	2.083
Philippines	230	480	730	.32	.18	3	3	0.150	0.147	0.131	0.070	0.078	0.199	0.309
Singapore	950	3310	11160	.54	.53	3	2	0.237	0.340	0.617	0.122	0.257	.	.

(table con'd.)

Nation	GNP per capita 1970	1978	1990	GNP Growth Rates 1970-78	1978-90	Positions in the World System 1970	1980	Trade Centrality 1970	1978	1990	Capital Centrality 1970	1978	Labor Centrality 1970	1978
Thailand	210	530	1420	.40	.43	3	3	0.132	0.157	0.334	0.110	0.078	0.316	0.141
Cyprus	900	3150	8020	.54	.41	3	-	0.022	0.021	0.026	0.050	0.043	0.001	0.020
Hurgary	410	1500	2780	.56	.27	3	3	0.111	0.107	0.138	0.050	0.043	0.459	0.205
Turkey	400	1220	1640	.48	.13	3	3	0.146	0.155	0.226	0.050	0.043	1.316	1.415
Iran	380	1970	2490	.71	.10	3	-	0.248	0.678	0.218	0.133	0.054	.	.
Israel	1830	4260	10920	.37	.41	3	3	0.112	0.128	0.142	0.050	0.043	0.225	0.218
Chile	840	1330	1940	.26	.16	3	3	0.171	0.090	0.103	0.050	0.068	0.193	0.251
Colombia	340	850	1260	.40	.17	3	3	0.103	0.087	0.082	0.075	0.068	0.429	0.576
Peru	520	840	1160	.21	.14	3	3	0.105	0.062	0.043	0.050	0.043	0.043	0.054
Algeria	360	1380	2060	.58	.17	4	3	0.151	0.257	0.139	0.113	0.278	.	.
Morocco	260	650	950	.40	.16	4	3	0.078	0.217	0.074	0.073	0.098	0.260	0.279
Tunisia	280	930	1440	.52	.19	4	3	0.030	0.053	0.061	0.059	0.046	0.103	0.138
Kenya	130	310	370	.38	.08	4	-	0.051	0.056	0.047	0.050	0.043	0.392	0.464
Indonesia	80	370	570	.67	.48	4	-	0.164	0.321	0.278	0.202	0.096	0.079	0.506
Sri Lanka	180	260	470	.16	.26	4	4	0.049	0.031	0.032	0.050	0.043	0.140	0.084
Malta	760	2090	6610	.44	.50	4	-	0.018	0.014	0.018	0.050	0.043	0.006	0.021
Poland	250	1170	1690	.67	.16	4	-	0.188	0.229	0.203	0.050	0.043	1.629	0.989
Egypt	230	410	610	.25	.17	4	3	0.130	0.144	0.099	0.538	0.683	0.219	0.527
Iraq	--	--	--	.	.	4	-	0.133	0.280	0.112	0.112	0.273	0.083	0.119
Libya	1870	7000	5500	.57	-.10	4	3	0.181	0.268	0.106	0.109	0.194	0.143	0.289
Saudi Arabia	560	7720	7060	1.14	-.04	4	-	0.227	1.121	0.483	0.307	0.359	0.436	0.306
Syrian Arab Rep.	360	1130	1000	.50	-.05	4	-	0.054	0.087	0.050	0.073	0.132	.	.
Costa Rica	560	1560	900	.44	.09	4	4	0.052	0.032	0.026	0.050	0.043	0.076	0.224
Dominican Rep.	330	900	830	.44	-.04	4	-	0.030	0.530	0.023	0.050	0.043	.	.
Ecuador	290	930	980	.51	.02	4	3	0.039	0.072	0.033	0.050	0.043	0.030	0.033
Honduras	270	530	590	.29	.05	4	4	0.028	0.020	0.011	0.050	0.043	0.203	0.195
Mexico	820	1580	2490	.28	.20	4	-	0.173	0.222	0.395	0.106	0.150	0.805	1.187
Panama	680	1290	1850	.28	.16	4	-	0.111	0.033	0.030	0.050	0.052	0.024	0.037
Cameroon	180	500	960	.44	.28	5	4	0.029	0.027	0.023	0.050	0.043	0.001	0.434
Congo	240	530	1010	.34	.28	5	5	0.008	0.009	0.011	0.050	0.043	0.142	0.182
Liberia	300	540	470	.26	-.06	5	-	0.027	0.020	0.036	0.050	0.043	0.121	0.093
Malawi	60	160	200	.43	.10	5	5	0.011	0.008	0.006	0.050	0.043	0.618	0.453
Mali	70	170	270	.39	.20	5	-	0.004	0.006	0.007	0.050	0.043	0.112	0.276
Mauritius	280	1020	2250	.56	.34	5	-	0.008	0.015	0.020	0.050	0.043	0.106	0.011
Rwanda	100	180	310	.48	.24	5	-	0.011	0.004	0.004	0.050	0.043	0.367	0.386
Tanzania	100	230	110	.36	-.32	5	-	0.044	0.023	0.011	0.050	0.043	0.389	0.502
Bangladesh	100	110	210	.04	.28	5	-	0.002	0.019	0.035	0.050	0.043	0.099	0.119
Lebanon	--	--	--	.	.	5	-	0.065	0.039	0.028	0.262	0.077	0.058	0.114

(table con'd.)

Nation	GNP per capita 1970	1978	1990	GNP Growth Rates 1970-78	1978-90	Positions in the World System 1970	1980	Trade Centrality 1970	1978	1990	Capital Centrality 1970	1978	Labor Centrality 1970	1978
Jamaica	720	1420	1500	.29	.02	5	-	0.042	0.037	0.021	0.050	0.043	.	.
Uruguay	740	580	2560	.33	.21	5	-	0.041	0.028	0.025	0.050	0.068	.	.
Iceland	2420	9930	22050	.61	.35	-	-	0.026	0.022	0.018	0.077	0.060	0.006	0.011
China	130	220	370	.23	.23	-	-	0.276	0.276	0.824	0.050	0.043	1.513	2.443
Macau	--	--	--	.	.	-	-	0.042	0.010	0.020	.	.	0.223	0.092
Vietnam	--	--	--	.	.	-	-	0.028	0.014	0.015	.	.	.	.
Taiwan	292	1304	6000	.65	.66	-	-	0.172	0.346	0.730	.	.	.	.
Bahamas, The	2700	3670	11420	.13	.49	-	-	0.074	0.092	0.024	0.050	0.043	0.115	0.000
Bahrain	1250	5600	6900	.65	.09	-	-	0.044	0.066	0.041	0.216	0.758	.	.
Kuwait	3350	15290	16650	.66	.04	-	-	0.189	0.249	0.075	0.729	1.066	0.000	0.001
United Arab Emirates	4350	21070	19860	.69	-.03	-	-	.	.	0.198	0.246	0.179	0.010	0.176
Bulgaria	340	1010	2250	.47	.35	-	-	0.067	0.046	0.038	0.050	0.043	0.126	0.128
Cuba	--	--	--	.	.	-	-	0.047	0.042	0.028	.	.	0.393	0.323
Czechoslovakia	690	1915	3140	.44	.21	-	-	0.180	0.129	0.185	0.050	0.043	0.565	1.417
German Democratic Rep.	--	--	--	.	.	-	-	0.117	0.105	0.075	.	.	0.048	0.043
Romania	230	1010	1620	.64	.21	-	-	0.305	0.350	0.129	0.124	0.078	0.017	0.043
USSR	--	--	--	.	.	-	-	0.645	0.724	0.766	.	.	1.260	1.885

[a]A β value of.8 is used in calculating the centrality scores.
[b]GNP growth rates are differences of logs between time 1 (1970, 1978) and time 2 (1978, 1990).
[c]Source: Snyder and Kick (1979), Bollen (1983), Bollen and Appold (1993).

approach only further confound the questionable GNP measure to the general validity of clustering models.

Measuring a distinct indicator of world-system position, namely a country's position in the world system is believed to be the most essential analytic tool in consistent with world-system theory. However, the effects of world-system position are controversial because the results are highly sensitive to the sample size and composition. While a more relational view of international exchange has been adopted by dependency/world-system perspective, the results simply lead to a conclusion that "hierarchical clustering algorithms offer the best method to identify empirical break points" (Smith and White 1992). Thus, determination of boundaries between a set of zones remains as the theme of most world-system studies. Chase-Dunn's assertion provides a sound criticism toward research that attempts to delineate world-system stratification.

> "the vocabulary of zones is just a shorthand. I don't see any advantage in spending time trying to define and empirically locate he boundaries between zones because I understand the core/periphery hierarchy as a complex continuum. Since there is upward and downward mobility in the system there must be cases of countries or areas which are in between zones, at least temporarily. For me it doesn't matter whether there are "really" three zones, four zones, or twenty zones." (Chase-Dunn 1989, p.214).

Although typological results may reflect differential industrial structures and developmental outcomes for particular countries, this aggregate level of

interpretations on world economic growth still fails to transform the analyses into a general comparative scheme. Besides, previous network analyses wasted a great deal of information for the metric measures because they either reduced each cell to a zero or a one, or were simply interested in grouping countries into certain categories. Thus, the differences of results were due more to interpretations of relational network than to the different measuring techniques.

Changes in the Global Hierarchy

This research presents a multidimensional global hierarchical structure in terms of trade, capital, and labor networks. These transactional networks are indicators of the economic basis of national domination in a capitalist world-economy. The centrality score measures the degree to which a country directly or indirectly mediates access to the entire economic networks, i.e., the degree to which it dominates the network interactions. Table 3 describes the trade network centrality score and rank for each year (1970, 1978, and 1990) and the percent change in centrality score across these 20 years. This table presents changes of dominant roles in the trade hierarchy. During the 20-year period, the number of dominant countries, countries with greater than average centrality scores (>1.0) in 1970, 1978, or 1990, stays at 9. Besides, except

Table 3. Predominant Changes in Trade Network Centrality, 1970-1978 and 1978-1990

Nation	1970 Centrality Score	1970 Rank	1978 Centrality Score	1978 Rank	1990 Centrality Score	1990 Rank	Percent Change in Centrality Score 1970-1978	1978-1990	1970-1990
Declining Dominance									
United States	6.241	1	5.705	1	5.724	1	-8.58	.33	-8.29
United Kingdom	2.955	3	2.564	5	2.456	5	-13.24	-4.22	-16.90
Canada	1.426	8	1.602	8	1.365	9	12.33	-14.80	-4.29
Sweden	.867	10	.800	11	.670	17	-7.68	-16.27	-22.70
Finland	.655	12	.312	31	.328	28	-52.34	5.00	-49.96
Australia	.568	14	.568	17	.472	21	-0.05	-16.75	-16.79
Denmark	.483	15	.457	21	.399	23	-5.29	-12.85	-17.46
Norway	.385	18	.419	23	.379	25	8.78	-9.48	-1.54
South Africa	.330	21	.284	32	.186	38	-13.83	-34.42	-43.49
Yugoslavia	.318	22	.339	29	.249	32	6.55	-26.53	-21.72
Romania	.305	23	.352	26	.129	46	14.83	-63.19	-57.73
Argentina	.257	26	.228	40	.129	47	-11.46	-43.43	-49.91
New Zealand	.233	29	.137	51	.114	48	-41.08	-17.21	-51.22
Panama	.111	54	.033	73	.030	70	-70.29	-7.87	-72.63
Zambia	.103	59	.034	72	.028	72	-66.62	-17.78	-72.56
Ghana	.056	66	.044	68	.018	85	-21.77	-59.66	-68.44
Increasing Dominance									
German Fed. Rep.	4.133	2	4.327	2	4.552	2	4.70	5.21	10.16
Japan	2.879	4	2.992	3	3.347	3	3.93	11.84	16.23
France	2.381	5	2.644	4	2.731	4	11.05	3.31	14.73
Italy	1.867	6	1.914	6	2.220	6	2.53	14.96	17.87
Spain	.435	16	.596	16	.872	10	37.15	46.26	100.59
Hong Kong	.365	19	.435	22	.784	13	18.97	80.33	114.54
China	.276	25	.277	34	.825	12	.24	197.92	198.64
Singapore	.238	28	.341	28	.617	18	43.44	81.07	159.73
Malaysia	.226	31	.246	38	.365	26	8.47	48.50	61.08
Mexico	.174	38	.222	41	.396	24	27.97	78.17	128.00
Taiwan	.172	39	.347	27	.731	16	101.35	110.80	324.44
Korea	.151	45	.372	25	.737	15	146.65	97.93	388.19
Turkey	.147	47	.155	47	.226	34	5.92	45.60	54.21
Thailand	.132	49	.158	46	.334	27	19.44	111.71	152.87
Tunisia	.031	79	.054	66	.062	58	75.36	15.29	102.18
Bangladesh	.003	93	.019	84	.035	66	600.80	83.55	1186.31

Japan, all other dominant countries were concentrated in either Western Europe or North America. Only Saudi Arabia jumped up to the top tier in 1978, while the global economy experienced two oil crises in the 1970s. However, by 1990, the increasing competition in the trade network leaves only four countries (West Germany, Japan, France, and Italy) still capable of achieving constant progresses in their rank and score of trade centrality. While the decrease of centrality score and rank occurs in countries across all regions in the world economy, especially the Scandinavian countries, most sharp increases are concentrated in the Pacific Rim area. The results may well reflect the expected beneficial effects of increasing transactional interactions in the trade network. China's initiation of the open-door policy in 1978 certainly contributes both direct and indirect influences on increase of trade gains within the region.

Table 4 depicts the capital network centrality score and rank for 1970 and 1978 and the percent change in centrality score in this period. The result shows that capital network reflect a much more dynamic and unstable transformation compared to that of trade. Countries experiencing declining trade centralities such as United States and Scandinavian countries were achieving increasing prominence in the capital network. On the other hand, despite declining centrality score, the hegemon in the

Table 4. Predominant Changes in Capital Network Centrality, 1970-1978

Nation	1970 Centrality Score	1970 Centrality Rank	1978 Centrality Score	1978 Centrality Rank	Percent Change in Centrality Score
Declining Dominance					
United Kingdom	7.985	1	6.900	1	-13.59
Switzerland	1.866	5	.743	12	-60.20
Australia	1.024	8	.850	10	-16.97
Italy	.747	9	.614	14	-17.87
Canada	.646	11	.449	16	-30.42
Lebanon	.263	19	.077	41	-70.62
United Arab Emirates	.247	20	.180	27	-27.19
Brazil	.226	21	.165	28	-26.76
Indonesia	.202	23	.097	36	-52.03
Portugal	.150	25	.059	47	-60.52
Iran	.133	27	.055	48	-58.97
Romania	.125	29	.078	40	-36.98
Iceland	.077	36	.060	46	-22.36
Increasing Dominance					
United States	3.723	2	4.107	2	10.31
France	1.923	4	3.231	3	67.96
Japan	1.303	7	1.419	7	8.90
Kuwait	.729	10	1.067	9	46.24
Netherlands	.464	13	1.694	5	264.64
Hong Kong	.450	14	1.515	6	236.94
Sweden	.380	16	.511	15	34.61
Finland	.266	18	.398	18	49.67
Bahrain	.216	22	.758	11	250.86
Denmark	.181	24	.419	17	131.27
Malaysia	.145	26	.198	25	36.77
Singapore	.122	30	.257	23	110.11
Greece	.121	31	.201	24	66.54
Algeria	.114	32	.278	21	144.32
Iraq	.113	33	.273	22	142.34
Spain	.055	47	.114	33	106.22

capital network, United Kingdom, still strove to hold the top rank. The result may correspond to Wallerstein's (1984) assumption on three stages of a hegemony: the initial competitive advantage in the provision of production will be replaced by capital investment, and eventually the export of financial services will perform the core function for the world-economy. This is because the centrality in financial services exchange that developed following earlier centrality in production is an important resource for the national economy and for the functioning of the larger world economy.

Table 5 presents the labor network centrality score and rank for 1970 and 1978 and the percent change in centrality score between these years. The most noticeable change in the formation of international labor network is the increase of the number of dominant countries from 14 to 17. Unlike trade and capital network, the shift of prominence in the labor flows are much more profound. Nearly half of the dominant countries experienced more than 10 percent decrease in their labor centralities. Conversely, countries experienced increasing centrality in the labor network are virtually from the subdominant or lower order tiers of the hierarchy, with the exception of Netherlands which is considered to be one of the dominant countries. From the world-system perspective, there is a clear shift in dominance of labor centrality in terms of

Table 5. Predominant Changes in Labor Network Centrality, 1970-1978

Nation	1970 Centrality Score	1970 Rank	1978 Centrality Score	1978 Rank	Percent Change in Centrality Score
Declining Dominance					
United States	6.025	1	5.467	1	-9.27
German Fed. Rep.	2.960	2	2.629	2	-11.19
Italy	2.838	3	2.120	6	-25.31
Canada	1.892	8	1.534	10	-18.91
Poland	1.629	9	.989	18	-39.30
Spain	1.352	11	1.167	14	-13.69
Argentina	1.071	14	.929	20	-13.21
Japan	.719	19	.506	34	-29.61
Ghana	.716	21	.379	40	-47.07
Switzerland	.625	23	.517	32	-17.21
Malaysia	.566	26	.067	69	-88.23
Hungary	.459	32	.206	54	-55.15
Saudi Arabia	.436	34	.307	44	-29.72
Thailand	.317	41	.141	58	-55.41
Macau	.224	46	.093	67	-58.44
Bahamas, The	.116	60	.001	80	-99.31
Increasing Dominance					
China	1.514	10	2.443	4	61.38
USSR	1.261	13	1.885	9	49.57
Mexico	.806	18	1.187	13	47.40
Venezuela	.703	22	.932	19	32.66
Czechoslovakia	.565	27	1.418	11	150.82
Netherlands	.477	30	.548	29	14.81
Nigeria	.464	31	.781	22	68.28
Korea	.423	36	1.087	15	156.97
New Zealand	.243	44	.328	41	34.86
Egypt	.219	47	.528	30	140.78
Philippines	.200	50	.309	43	54.70
Libya	.143	55	.290	45	102.59
Mali	.112	61	.276	47	145.76
Indonesia	.079	66	.507	33	538.37
Costa Rica	.077	67	.225	51	193.23
United Arab Emirates	.011	74	.177	57	1554.86

core/periphery hierarchy. The result may reflect Lubeck and Palmer's (1990) assertion that most peripheral countries' ethnic identities and roles in the division of labor were shaped by the era of formal colonialism. By 1970, the end of imperialism followed by the increase of multinational corporations has further intensified the movement of labor between countries. Hence, we can expect an continuing redistribution of population and labor in the process of international ethnic division of labor.

Mobility - The Vertical Dimension

As seen in Tables 3, 4, and 5, the international production network is a complex system with an multilevel hierarchy. Table six through ten were constructed to further display the dynamics of vertical mobility within each transactional network for different time periods. It is clear that the relatively small size and corresponding component of dominant country within the trade network remained virtually unchanged during all three time periods. In other words, the phenomenon of domination by a small number of countries is in somewhat stable but shifting alliances. Historically, the new phase of world trade has started since the end of the Second World War, dominated by the hegemony of the United States (Baran and Sweezy 1966; Sunkel 1973). This internationalization process renewed the growth of world trade within nearly all

Table 6. Mobility Within Trade Network by Levels of Centrality: 1970-1978

1978	1970 Level of Centrality >1.0	.30-1.0	.15-.29	.08-.14	.03-.07	<.03
Centrality >1.0	US German F.R. UK Japan France Italy Netherlands Canada Belgium		Saudi Arabia			
Centrality .30-1.0		Sweden Switzerland Finland USSR Australia Denmark Spain Austria Norway Hong Kong Brazil Romania Yugoslavia	Iran Venezuela South Korea Taiwan Singapore Indonesia	Nigeria		
Centrality .15-.29		South Africa	China Malaysia Kuwait Poland Argentina Greece Libya Mexico Ireland India Algeria	Iraq Thailand Turkey	Morocco	
Centrality .08-.14			Portugal New Zealand Czechoslovakia Chile	Philippines Egypt German D.R. Israel Hungary Colombia	Cote d'Ivoire Bahamas Syria	
Centrality .03-.07				Panama Pakistan Peru Zambia	Bulgaria Lebanon Ghana Costa Rica Kenya Sri Lanka Cuba Bahrain Jamaica Ecuador Tunisia	
Centrality <.03					Angola Tanzania Macau Uruguay	Cameroon Honduras Liberia Iceland Cyprus Congo Bangladesh

Note: Closeness Measure (β=.8) is used for the classification of levels of centrality.

Table 7. Mobility Within Trade Network by Levels of Centrality: 1978-1990

1990	1978 Level of Centrality >1.0	.30-1.0	.15-.29	.08-.14	.07-.03	<.03
Centrality >1.0	US German F.R. Japan France UK Italy Netherlands Canada Belgium					
Centrality .30-1.0	Saudi Arabia	Sweden Switzerland USSR Spain Australia Brazil Austria Denmark Hong Kong Norway South Korea Taiwan Singapore Finland	China Mexico Malaysia Thailand			
Centrality .15-.29		Iran Venezuela Yugoslavia Indonesia	India Ireland Turkey Poland Greece South Africa	Portugal Czechoslovakia		
Centrality .08-.14		Nigeria Romania	Algeria Argentina Iraq Libya	Philippines Egypt New Zealand Israel Hungary Chile Colombia	Pakistan	
Centrality .03-.07				German D.R. Tunisia Syria Kuwait	Tunisia Kenya Peru Bahrain Bulgaria Ecuador Sri Lanka Panama	Liberia Bangladesh Angola
Centrality <.03				Morocco	Cuba Lebanon Zambia Costa Rica Bahamas Jamaica Ghana	Cyprus Uruguay Cameroon Mauritius Macau Malta Iceland Congo Tazania Honduras Mali Malawi Rwanda

Note: Closeness Measure (β=.8) is used for the classification of levels of centrality.

Table 8. Mobility Within Trade Network by Levels of Centrality: 1970-1990

1990	1970 Level of Centrality >1.0	.30-1.0	.15-.29	.08-.14	.03-.07	<.03
Centrality >1.0	US German F.R. UK Japan France Italy Netherlands Canada Belgium					
Centrality .30-1.0		Sweden Switzerland Finland USSR Australia Denmark Spain Austria Norway Hong Kong Brazil	China South Korea Taiwan Singapore Saudi Arabia Mexico Malaysia	Thailand		
Centrality .15-.29		South Africa Yugoslavia	India Indonesia Portugal Ireland Iran Greece Poland Czechoslovakia Venezuela	Turkey		
Centrality .08-.14		Romania	Argentina New Zealand Libya Chile Algeria	Israel Hungary Nigeria Philippines Iraq Egypt Pakistan Colombia		
Centrality .03-.07			Kuwait	German D.R. Peru Panama	Morocco Tunisia Syria Kenya Cote d'Ivoire Bahrain Bulgaria Ecuador Sri Lanka	Bangladesh
Centrality <.03				Zambia	Cuba Lebanon Costa Rica Uruguay Bahamas Dominican R. Jamaica Macau Ghana Tazania	Cyprus Cameroon Mauritius Malta Iceland Congo Honduras Mali Malawi Barbados Rwanda

Note: Closeness Measure (β=.8) is used for the classification of levels of centrality.

economic sectors (including the private service sectors). Meanwhile, the rise of transactional corporations (TNCs) distinguished by direct investments abroad in a wide range of industries marks another new feature (Vernon 1971; 1977; Barnet and Müller 1974). Moreover, a variety of political and technological factors facilitated the international expansion of trade in the postwar era. Beginning in the 1970s, the hegemony of the United States began to show signs of weakening (Amin, Arrighi, Frank, and Wallerstein 1982; Weber 1983; Bousquet 1980). Combined with increased protectionism employed by advanced countries in an attempt to cope with the rapid growth of manufactured exports from the newly industrialized countries (Yoffie 1983), a competitive condition emerged as dominant nations seek to increase their shares of the world market.

Table 9 shows that capital network has a comparable small size of dominant countries. However, in the highest tier of the hierarchy, their positions are relatively insecure. Two countries (Australia and Switzerland) show downward mobility, and three countries (Hong Kong, Netherlands, and Kuwait) move up from one tier below. Unlike trade network, capital flows are more sensitive to the regulation of markets. The international monetary system became much more unstable after the United States decided to abandon the gold standard in 1971 (Block 1977). The deregulation of European and Japanese financial markets

Table 9. Mobility Within Capital Network by Levels of Centrality: 1970-1978

1978	1970 Level of Centrality >1.0	.25-1.0	.10-.24	.05-.09	<.05	
Centrality >1.0	UK US Belgium France German F.R. Japan	Hong Kong Netherlands Kuwait				
Centrality .25-1.0	Australia Switzerland	Italy Canada Egypt Norway Sweden Saudi Arabia Finland	Bahrain Denmark Algeria Iraq Singapore			
Centrality .10-.24			UAE Brazil Malaysia Austria Greece Libya Mexico	Syria New Zealand Spain	Korea	
Centrality .06-.09		Lebanon	Indonesia Portugal Iran Romania Thailand	Iceland Colombia Morocco Philippines Venezuela		
Centrality <.05				South Africa Tunisia Yugoslavia Barbados Ireland Chile India Czechoslovakia Hungary Sri Lanka Jamaica Honduras Cameroon Congo Panama Ghana Cote d'Ivoire Tazania China Bahamas	Malta Rwanda Bulgaria Turkey Kenya Cyprus Pakistan Bangladesh Poland Uruguay Malawi Argentina Nigeria Ecuador Israel Peru Mauritius Dominican R. Zambia	Liberia Costa Rica Mali

Note: Closeness Measure (β=.8) is used for the classification of levels of centrality.

in the mid-1970s further led to an increase globalization of the capital market (Mizruchi and Stearns 1994). Additionally, the transition of domination occurred as Gerschenkron (1962) argued that credit-based systems, such as France, Germany, and Japan, are solutions to late development while the capital market-based systems, such as the United States and the United Kingdom, are tied to an earlier industrial transformation. Credit-based systems differ to the degree that the banks themselves are dependent on the government for funds.

Table 10 presents mobility within labor network by levels of centrality. During 1970-1978, seven out of thirteen countries in the top level experienced decreasing centrality in the labor network, within which Spain and Poland further descended to the next tier. Besides, another five advanced economies including the United States, West Germany, Italy, France, and Canada, were all experiencing downfalls in labor centrality. This result may correspond to the argument that the patterns of migration flows were determined by uneven development, that is, by the increasingly divergent rates of economic growth in different sectors of the world-economy (Davis 1974; Thomas 1954). Moreover, the growing interdependence at the international level may spur increasing labor movements. However, the issue of ethnic enclaves also plays a pivotal part in the processes of integration into the global

Table 10. Mobility Within Labor Network by Levels of Centrality: 1970-1978

1978	1970 Level of Centrality >1.2	.50-1.2	.30-.54	.20-.29	.08-.19	<.08
Centrality >1.2	US German F.R. Italy UK India Pakistan France Canada China Turkey USSR	Czechoslovakia				
Centrality .55-1.2	Spain Poland	Argentina Mexico Portugal Australia Venezuela Brazil Yugoslavia Greece South Africa Sweden Switzerland	Nigeria Colombia Netherlands Korea			
Centrality .30-.54		Japan Malawi Ghana	Belgium Saudi Arabia Cuba Kenya Tazania Rwanda	Egypt Philippines New Zealand	Indonesia	
Centrality .20-.29			Hungary	Zambia Morocco Israel Finland Austria	Libya Chile Mali	Costa Rica
Centrality .08-.19			Thailand	Macau Honduras	Ireland Denmark Congo Sri Lanka Bulgaria Liberia Tunisia Bangladesh Iraq	UAE Lebanon
Centrality <.08					Mauritius Bahamas	German D.R. Ecuador Panama Romania Peru Malta Iceland Kuwait Cyprus

Note: Closeness Measure (β=.8) is used for the classification of levels of centrality.

division of labor (Bonacich 1973); namely, the articulation of internal and external (national and global) labor flows. As Enloe (1980) suggests, both the state and any given ethnic group must be seen as dynamic, as historical.

By and large, changes of dominant positions in these production networks over the 20-year period is gradual and moderate. As Chase-Dunn contends,

> "Core states do not decline absolutely. The entire world-economy continues to grow, albeit at different rates. What happens is that core states relatively lose their hegemony, but they do not plunge into the periphery. The most important cause of relative decline is the spread of leading core industries to other competing core countries, and to parts of the semiperiphery." (Chase-Dunn 1989, p.175).

The most significant and consistent change across trade, capital, and labor networks is the extensive movements of positions in the subdominant level. While a few countries in the lower order level achieved certain degree of upward mobility, the number of countries that experienced downward mobility is just as frequent, or even higher. The phenomenon can be manifested by trade network from 1970-1990 (table 8), the ratio of upward to downward mobility is drastically dropped from 8 to 3 for subdominant countries, to 1:6, 0:4, and 2:10 for tier 2 through 5, respectively.

This pattern of extensive upward mobility for subdominant countries is analogous to that of semiperipheral nations as asserted by world-system

theorists. However, the autonomous role each country has played in the global networks is ignored. Instead, studies of the world system offer explanations primarily based on the conception of the "new international division of labor." It is claimed that leaving one structural position implies taking on a new role in the international division of labor, rather than escaping from the system. Namely, change of status in the economic hierarchy is at best a result of "development by invitation" or "dependent development." (Martin 1990). Nonetheless, a number of theorists have become more skeptical to the literature as the international economy has entered a new phase of "global capitalism" (Ross and Trachte 1990). Gereffi (1994) contends that it is outdated to assert that as the international division of labor widened, the economic functions of states became increasingly divided between those specializing in diversified manufacturing at one pole, and those specializing in the production of primary products for export at the other.

Another common explanation suggested by world-system analysts is the phenomenon of capital flight and the accompanied result of deindustrialization within the core. It also has been frequently cited in the contemporary United States as an explanation for the migration of capital from the Northeast to the Sunbelt, and out of the country altogether (Goldfrank 1983). However, Abowd and

Freeman (1991) suggest that industrialization has been replaced as the basis of core activities by the growing importance of vertically integrated transactional corporations (TNCs) in all branches of economic activity (from agriculture and mining to manufacturing, distribution, and banking). Hence, the increasing interaction between nations and TNCs has served to dissolve and blur any previously existing correlation between the core-periphery dichotomy and dichotomies based on the specific kind of commodities produced (e.g. manufacturing vs. agriculture) or even on the techniques of production used (e.g. high productivity vs low productivity).

Current studies (e.g. Evans and Stephens 1988; Gereffi 1994) suggest that we need to disaggregate roles of semiperipheral nations and focus on the specific features of the NICs in different geographical regions. Many studies have examined countries located within the semiperipheral zone, such as South Korea and Taiwan in East Asia, Mexico and Brazil in Latin American, India and South Asia, and Nigeria and South Africa in Africa (Biersteker 1987; Bradshaw 1988; Encarnation 1989; Evans 1979; Gold 1981; Lim 1985; Moran 1974). However, most of them merely provide an ad-hoc rationalizations of policy directions, or are limited in their ability to analyze concrete development trajectories of countries and regions that are similarly

situated, but responds differently to external economic challenges.

The present analysis shows consistently that the rise and decline of each country or region within the multiple-network hierarchy results from their degree of involvement into the global economy. Additionally, position in these transactional networks determines the role of national economies within each international economic activity. It is still debatable if the upward movements of countries in the subdominant and lower order level lead to possibilities for autonomous paths of development or simply result in another form of dependence. Nevertheless, the consequences of nonincorporation or marginalization in the global economy, such as sub-Saharan Africa, may cause the severest problems of all.

Declining Network Centralization

In the past decade, considerable attention has been given to the emphasis of a new trend of a regioncentric production network and the uniqueness of regional trading blocs within the world economy (Hansen et al. 1990; Kiel and Howard 1988). However, discussions in the previous sections have shown that the world economy is indeed hierarchically organized, with a few advanced countries dominating the multiple networks of production. Stated differently, this new pattern of geographical

specialization in production networks still remain incorporated into the global transactional system.

Whereas the dominant countries still maintain extensive production relations with each of the other major regions, the formation and pattern of domination may have undergone significant changes. The trend of transformation may be from superimperialism to ultraimperialism within the dominant countries (Goldfrank 1983), as well as polarization to multilateralization of regional trading blocs (Gereffi 1994). Table 11 through 13 presents the Freeman statistics for centralization of the trade, capital, and labor networks for the world economy as a whole and regions in 1970, 1978, and 1990 (trade network only). Regional centralization relative to world production networks and regional centralization relative to all countries within the same region are presented.

Simply stated, the measure of overall network centralization indicates the degree to which a network is dominated by a few countries. In global production networks, the statistic yields a value of 1.0 when one country mediates all exchanges within a network. When all countries have equal centrality, namely no country dominates exchanges, the Freeman statistic is zero. As seen in Table 11, the overall level of centralization in the trade hierarchy declined from .61 to .55 between 1970 and 1978. Hence, the domination of network hierarchy by one

power or few countries such as the United Kingdom and the United States, is giving way to a pattern of competitive interdependence.

Results of overall centralization in capital and labor networks are consistent with that of trade network. Capital network has experienced dramatic declines in centralization, from .85 to .72 (Table 12). The degree to which the hierarchy of labor network was dominated by a few countries also decreased from .61 to .54 between 1970 and 1978 (Table 13). In general, disparities among countries in levels of centrality were significantly lessened over the past two decades. There has emerged a more decentralized exchange structure among countries within the system as a whole.

A region's prominence within the world economy weakens as the centrality of its dominant country declines. Although North and Latin American and Western Europe continued to retain shifting dominance among three production networks, these regions' centrality within the world system and region have started to decline. On the other hand, Asian Pacific and South Asia has achieved remarkable increases in centrality scores across all transactional networks. Japan's outstanding performance in the global economy has contributed to this region's prominence within the world system and also accounted for the rise in centralization within Asian Pacific and South

Table 11. Level of Centralization in Trade Network: the world and Regions, 1970, 1978, and 1990.

	Level of Centralization						
	Within the World[a]			Within Regions[b]			Number
Region	1970	1978	1990	1970	1978	1990	of Cases
the World System	.61	.55	.55	--	--	--	93
North and Latin America	.61	.55	.55	1.39	1.25	1.28	19
Western Europe	.39	.41	.43	.75	.80	.85	19
Asian Pacific/South Asia	.26	.27	.30	.68	.70	.75	16
Eastern Europe	.02	.03	.03	.15	.17	.19	11
Southwest Asia/North Africa	.00	.07	.01	.04	.27	.12	11
Subsaharan Africa	.00	.00	.00	.07	.09	.04	17

[a] Centralization relative to the entire world-system network.
[b] Centralization relative to other countries within each region.

Table 12. Level of Centralization in Capital Network: the world and Regions, 1970 and 1978.

	Level of Centralization				
	Within the World[a]		Within Regions[b]		Number
Region	1970	1978	1970	1978	of Cases
the World System	.85	.72	--	--	82
Western Europe	.85	.72	1.69	1.41	19
North and Latin America	.37	.41	.88	.98	17
Asian Pacific/South Asia	.10	.12	.34	.37	12
Southwest Asia/North Africa	.04	.07	.16	.25	10
Eastern Europe	.00	.00	.03	.01	9
Subsaharan Africa	.00	.00	.01	.00	15

[a] Centralization relative to the entire world-system network.
[b] Centralization relative to other countries within each region.

Table 13. Level of Centralization in Labor Network: the world and Regions, 1970 and 1978.

Region	Level of Centralization: Within the World[a] 1970	Within the World[a] 1978	Within Regions[b] 1970	Within Regions[b] 1978	Number of Cases
the World System	.61	.54	--	--	80
North and Latin America	.61	.54	1.43	1.28	15
Western Europe	.26	.22	.50	.43	18
Asian Pacific/South Asia	.19	.20	.50	.49	13
Eastern Europe	.11	.14	.36	.42	11
Southwest Asia/North Africa	.00	.00	.11	.10	9
Subsaharan Africa	.01	.01	.12	.12	14

[a] Centralization relative to the entire world-system network.
[b] Centralization relative to other countries within each region.

Asia. sub-Saharan Africa persisted in exhibiting the greatest disparities from the other regions due to its partial or uneven links to the global economy.

As yet, however, the cycle of competition among core nations has not resulted in a multicentered system - one with a well-defined multilevel hierarchy. Declining network centralization was expected to distribute dominance of the core nations throughout the countries in the subdominant regions. However, after further examining centrality scores of each region, the hypothesis was not supported. Only core countries within three regions (North and Latin America, Western Europe, and Asian Pacific and South Asia) have centrality scores greater than 1.00. The result indicates that while the degree to which a network is dominated by a few countries has decreased, no new center emerged in the world economy. Additionally, this trend of declines in trade network centralization is somewhat stagnated between 1978 and 1990.

Effects of Direct and Indirect Interactions

Centrality measures also provide analogous concepts in contrasting predominant theories through their approaches to spatial structure and development. In economic base approaches, the volume of exportation of a place is the major concern (Thompson 1965). Thus, the overall structure of the production networks are not emphasized, limiting the

scope of interaction to dyad. When centrality is determined by the number of direct contacts between pairs of points, degree centrality (β=0) is the corresponding measure. The political economy perspective, which drew heavily on Marxist beliefs of capitalist exploitation, is consistent with the concept of the competitive distance measure (β=-.8). Briefly, interactions with central places decrease the dominance of a given country while connections with less central countries increase its centrality. On the other hand, the ecological view of centrality involves the relationship of places to the broader sociospatial network. Hence, frequency of contact with the larger system and the extensive scope of interaction are central to a country's dominance within the global hierarchy. Closeness-based centrality (β=.8), which stresses the importance of both direct and indirect contacts and takes the relative position of other places into consideration, is suitable to ecological conceptions of dominance and hierarchy.

Table 14 shows the compatibility between centrality measures (degree, competitive distance, and closeness) and development theories (economic base, political economy, and ecological), using centrality scores and ranks of trade network between 1970 and 1990. The table presents most countries located within the subdominant level of the economic hierarchy, a critical structural position to world-system theorists.

Table 14. Competitive Distance, Degree, and Closeness Measures of Centrality in Economic Base, Political Economy, and Ecological Theories: Using Trade Network Measures, 1970-1990

	1970						1978						1990					
	Competitive		Degree		Closeness		Competitive		Degree		Closeness		Competitive		Degree		Closeness	
β=	-0.8		0		0.8		-0.8		0		0.8		-0.8		0		0.8	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
German F.R.	2.202	3	3.191	3	4.133	2	3.497	2	4.049	2	4.327	2	3.457	2	4.164	2	4.552	2
Japan	1.677	5	2.628	4	2.879	4	3.261	3	3.289	3	2.992	3	2.959	3	3.341	3	3.347	3
China	.285	11	.306	17	.276	25	.239	24	.303	27	.277	34	.444	15	.675	12	.825	12
Switzerland	.187	14	.465	12	.756	11	.357	17	.599	14	.752	12	.310	20	.589	14	.838	11
Belgium	.162	19	.696	8	1.340	9	.391	15	.925	8	1.428	9	.662	10	1.029	7	1.377	8
Norway	.101	30	.231	25	.385	18	.184	25	.327	26	.419	23	.390	17	.401	22	.379	25
Argentina	.081	32	.176	30	.257	26	.273	20	.282	28	.228	40	.208	32	.190	39	.129	47
Venezuela	.028	47	.122	37	.212	32	-.089	91	.421	19	.611	15	.219	28	.222	36	.157	40
Thailand	.016	52	.075	47	.132	49	.078	37	.130	47	.158	46	.183	35	.272	27	.334	27
Korea	-.002	66	.073	48	.151	45	-.011	85	.198	34	.372	25	.308	21	.564	16	.737	15
Algeria	-.009	76	.072	49	.151	44	-.110	92	.090	54	.257	36	.048	63	.101	50	.140	42
Nigeria	-.010	77	.061	60	.132	50	-.083	90	.196	35	.412	24	.148	40	.161	43	.137	44
South Africa	-.014	81	.159	32	.330	21	.101	32	.229	31	.284	32	.191	34	.206	37	.186	38
Turkey	-.017	82	.079	46	.147	47	.093	35	.131	46	.155	47	.182	36	.222	35	.226	34
Philippines	-.038	84	.056	62	.150	46	.001	82	.081	58	.148	49	.052	62	.098	51	.132	45
Indonesia	-.038	85	.063	59	.165	43	-.045	88	.161	38	.322	30	.076	51	.179	41	.278	30
Chile	-.043	86	.071	52	.171	41	.045	46	.078	61	.090	58	.084	47	.104	49	.103	51
Ireland	-.050	87	.071	51	.167	42	-.002	84	.114	50	.188	44	.021	73	.139	64	.248	33
Mexico	-.055	88	.068	53	.174	38	-.068	89	.101	52	.222	41	-.039	92	.231	34	.396	24
New Zealand	-.076	90	.096	42	.233	29	.075	38	.119	48	.137	51	.068	55	.092	53	.114	48
Panama	-.083	91	.030	70	.111	54	.037	50	.041	66	.033	73	.069	54	.056	64	.030	70
Finland	-.305	92	.235	23	.655	12	.174	27	.249	29	.312	31	.153	39	.253	29	.328	28
Canada	-.454	93	.654	9	1.426	8	-.574	93	.680	11	1.602	8	-.446	93	.627	13	1.365	9

Turning first to negative levels of β, and comparing the -.8 column for the period of 1970 and the -.8 column for 1978 and 1990, we can see that the competitive distance measure of position gives various results for all three time periods. New Zealand and Finland were both considered as developed countries, yet they were at the bottom of the hierarchy (90 and 92, respectively) in 1970, then moved drastically to the 38th and 27th rank in 1980, and eventually dropped to the 55th and 39th in 1990. Clearly, competitive distance measures have exaggerated the harmful effects of interactions with dominant countries.

Examining the column where β=0, we see that the degree-based conception of centrality better abridges rank differences for both time periods. Turning to the columns β=.8 we can see that the two levels of β give similar results. The higher level of β (.8) takes into account direct as well as indirect interactions in calculating closeness centrality. Moreover, the beneficial effects from extensive contacts, directly and indirectly, can be better pictured by the rise of countries which are usually cited as examples of "dependent development" in the subdominant level (e.g. South Korea and Thailand).

Nevertheless, competitive distance measures may have provided one distinctive feature to distinguish countries which are most likely to remain in the subdominant or lower levels. This feature which disadvantages upward mobility is

the lack of extensive trading partners. Canada, Mexico, and Ireland are the best examples. They all have limited and concentrated interactions with neighboring dominant countries, namely the United States and European Community countries. Lacking an extensive scope of transactional interactions is the major reason to classify Canada and Ireland as the "perimeter of the core" (cf. Grant and Lyons 1990; Niosi 1990).

CHAPTER SIX

EFFECTS OF TRANSACTIONAL NETWORKS ON ECONOMIC GROWTH

To assess the importance of linkages to the global transactional networks as a competitive factor affecting a country's economic growth, a multiple regression analysis is employed. The analysis introduced alternative variables which have been hypothesized to be determinants of economic growth in the world system. To assure the effects and measures to be more robust and appropriate for cross-national comparisons, all the estimates are based on difference-of-logs models. Moreover, the analysis was extended to two specific groups of nations: centrally planned economies and oil exporting countries. Contrasts were also made among different measure of the dependent variable, namely GNP per capita, PQLI, and HDI. Finally, a reduced-form model was utilized to evaluate the performance of network measures, net of controlling variables, on stimulating economic growth.

Results of Difference-of-Logs Models

Tables 15 and 16 report the estimated effects of key theoretical and control variables on change in a nation's economic growth between 1970 and 1978, and 1978 and 1990, respectively. Three different levels of β parameters, .8, 0, and -.8, are applied to centrality measures in

Table 15. Regression Coefficients for Economic Growth 1970-1978 on Selected Independent Variables, by Network Measures

	Network Measures					
	Closeness (β=.8)#		Degree (β=0)		Competitive Distance (β=-.8)	
Independent Variable	b	Beta	b	Beta	b	Beta
Economies						
OEC	.228**	.367	.252***	.406	.383***	.478
	(.078)		(.074)		(.307)	
CPE	.118*	.190	.141**	.227	.131**	.211
	(.065)		(.066)		(.063)	
All other countries	contrast		contrast		contrast	
Growth Rates						
Trade centrality	.152*	.223	.164**	.248	5.237***	.292
	(.085)		(.080)		(1.818)	
Capital centrality	.049	.050	.040	.041	-.185	-.022
	(.108)		(.101)		(.879)	
Labor centrality	.004	.007	-.003	-.007	-1.477	-.130
	(.059)		(.052)		(1.312)	
Capital penetration	-.321	-.161	-.312	-.157	-.356	-.179
	(.231)		(.228)		(.220)	
Primary export dependence	.112	.149	.116	.155	.107	.142
	(.096)		(.095)		(.095)	
Export intensity	-.086	-.142	-.086	-.141	-.069	-.114
	(.065)		(.064)		(.062)	
Labor intensity	.295	.110	.356	.133	.383	.143
	(.329)		(.312)		(.307)	
Capital intensity	.167	.101	.100	.061	.275	.167
	(.222)		(.228)		(.209)	
Defense expenditure	.071	.104	.053	.077	.053	.077
	(.073)		(.073)		(.070)	
Human capital investment	.041	.028	.041	.028	.100	.068
	(.179)		(.178)		(.169)	
Control Effects						
1970 GNP per capita	.114**	.343	.118**	.353	.110***	.330
	(.052)		(.051)		(.049)	
Largest variance inflation factor	2.192		2.355		2.339	
R^2	.425		.432		.469	
Adjusted R^2	.296		.305		.351	
Number of cases	72		72		72	

*p<.10 **p<.05 ***p<.01

#β parameters refer to centrality measures.

Note: CPE and OEC denote Centrally Planned Economies and Oil Exporting Countries, respectively. b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

Table 16. Regression Coefficients for Economic Growth 1978-1990 on Selected Independent Variables, by Network Measures

	Network Measures					
	Closeness (β=.8)#		Degree (β=0)		Competitive Distance (β=-.8)	
Independent Variable	b	Beta	b	Beta	b	Beta
Economies						
OEC	-.255***	-.368	-.357***	-.517	-.376***	-.544
	(.066)		(.070)		(.075)	
CPE	.040	.058	.044	.064	.055	.079
	(.059)		(.067)		(.071)	
All other countries	contrast		contrast		contrast	
Growth Rates						
Trade centrality	.374***	.481	.193***	.273	.028	.008
	(.072)		(.070)		(3.539)	
Capital penetration	.225	.058	.124	.032	.019	.005
	(.382)		(.432)		(.456)	
Primary export dependence	-.001	-.001	-.030	-.032	-.079	-.083
	(.086)		(.097)		(.105)	
Export intensity	-.128	-.142	-.076	-.084	-.041	-.045
	(.092)		(.103)		(.110)	
Labor intensity	-.103	-.082	-.121	-.096	-.120	-.095
	(.111)		(.126)		(.134)	
Capital intensity	.184	.102	.253	.140	.246	.136
	(.172)		(.194)		(.207)	
Defense expenditure	-.070	-.086	-.037	-.046	-.027	-.034
	(.068)		(.076)		(.081)	
Human capital investment	.264*	.150	.242	.137	.198	.112
	(.158)		(.179)		(.191)	
Control Effects						
1970 GNP per capita	.165***	.492	.199***	.594	.170***	.507
	(.030)		(.036)		(.036)	
Largest variance inflation factor	1.722		1.691		1.691	
R^2	.638		.536		.477	
Adjusted R^2	.572		.450		.381	
Number of cases	72		72		72	

*p<.10 **p<.05 ***p<.01
#β parameters refer to centrality measures.

Note: CPE and OEC denote Centrally Planned Economies and Oil Exporting Countries, respectively. b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

Table 17. Regression Coefficients for Economic Growth 1970-1990 on Selected Independent Variables, by Network Measures

	Network Measures					
	Closeness (β=.8)#		Degree (β=0)		Competitive Distance (β=-.8)	
Independent Variable	b	Beta	b	Beta	b	Beta
Economies						
OEC	-.063	-.067	-.086	-.090	-.074	-.078
	(.094)		(.102)		(.103)	
CPE	.163*	.171	.214**	.225	.198*	.208
	(.094)		(.104)		(.104)	
All other countries	contrast		contrast		contrast	
Growth Rates						
Trade centrality	.406***	.440	.233**	.292	6.668**	.238
	(.094)		(.092)		(2.874)	
Capital penetration	-.449*	-.174	-.505*	-.196	-.521*	-.202
	(.251)		(.273)		(.275)	
Primary export dependence	.106	.126	.117	.139	.103	.121
	(.099)		(.107)		(.108)	
Export intensity	-.126*	-.188	-.101	-.151	-.073	-.110
	(.067)		(.074)		(.074)	
Labor intensity	.033	.021	.063	.040	.176	.112
	(.183)		(.201)		(.197)	
Capital intensity	.345	.196	.472*	.269	.595**	.338
	(.242)		(.260)		(.260)	
Defense expenditure	-.036	-.041	-.096	-.110	-.123	-.141
	(.099)		(.106)		(.106)	
Human capital investment	.025	.015	-.019	-.011	-.090	-.053
	(.200)		(.218)		(.218)	
Control Effects						
1970 GNP per capita	.299***	.585	.345***	.675	.295***	.579
	(.069)		(.076)		(.076)	
Largest variance inflation factor	2.267		2.263		2.188	
R^2	.499		.406		.397	
Adjusted R^2	.407		.297		.286	
Number of cases	72		72		72	

*p<.10 **p<.05 ***p<.01

#β parameters refer to centrality measures.

Note: CPE and OEC denote Centrally Planned Economies and Oil Exporting Countries, respectively. b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

reflecting competitive theoretical perspectives, i.e., ecological, economic-base, and political economy.

A nation's position in trade centrality presents significant positive effects on economic growth for two consecutive time periods. Among the hypothesized alternative variables, however, significant positive effects were found only for investment in education, and weak or nonexistent effects were found for dependence and industrialization variables, as well as defense expenditure. Moreover, the effects of trade centrality on economic growth has gained more significance in the period between 1978 and 1990 than the previous period 1970-1978, the interval typical of dependency studies. The overall explanatory power of the predictor variables for economic growth in equations using closeness measures for network variables are superior to those of degree and competitive distance measures. The differences of R^2 in the second period are remarkable - the adjusted R^2 indicated that equations using closeness measures explained nearly 20 percent (.572-.381) more of the variance. The result depicts the increasing positive effects of indirect transactional interactions in accounting for growth in the global economy.

Table 17 further examines the effects of independent variables on economic growth for the pool years, i.e., 1970-1990. The coefficient for trade centrality maintains

the most significant predictor variable for economic growth. In addition, three alternatively hypothesized variables - capital penetration, export intensity, and capital intensity attain statistical significance. Another analogous finding is the disappearance of significant effect for economic growth when contrasting oil-exporting countries to all other countries. This is not surprising, considering all these variables are highly sensitive to relative prices changes, especially during the 1970s. For example, during the 1970s the total income of Saudi Arabia increased much more rapidly than its total output, due to changes in the price of oil relative to other goods (Firebaugh 1983). For this reason, further examination of the subsamples will be discussed in the following section.

Concerning the reliability of the results, special attentions is paid to some measurement problems. First of all, each equation uses logged variables (the difference-of-logs model) to lessen the vulnerabilities of results to high levels of skewness. In this logged form, all the regressors have lower levels of skewness compared to their original metric forms. Most of the regressors have skewness levels lower than or close to 1, with the exception of capital centrality when calculated using -.8 and 0 β parameter. Thus, these measures are eliminated from subsequent analysis. Since unstable levels of skewness may correlate with problems of outliers and inhibit the

usefulness of results, the possibility for outliers are screened using DFBETA statistic.[13] The possibility of multicollinearity is also considered, given the considerable zero-order correlations among some of the independent variables (see Appendix A and B). As a rule of thumb, to safeguard against multicollinearity problems, the largest variance inflation factor (VIF) cannot go beyond a value of 4. The largest VIF in the analysis is 2.468 throughout all models, suggesting rather weak dependence among the independent variables.[14]

The initial levels of GNP per capita is also included to test if the effects of network centralities have substantive meanings on economic growth. Although Jackman (1980) suggests that the adoption of the growth-rate model eliminates the need for an adjustment by initial value, it is common to suspect the effects of scale economy (Firebaugh 1983). Hence, the initial level of GNP per

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[13]The diagnostic checks for outliers identify Singapore and Dominican Republic as influential nations to the results. Equations are rerun omitting these countries. Although the influences are minimal and results are essentially the same with or without the outliers, these cases are excluded in avoidance of latent problems.

[14]Another way of detecting multicollinearity is established by computing a "condition index" which is the ratio of the largest eigenvalue extracted from a given X'X matrix to the eigenvalue for the given dependence. Condition indices in the range of 5 to 10 are indicative of the existence of a weak dependence, while indices in excess of 30 are indicative of strong relations. All condition indices were all less than 5 in this analysis. Again, multicollinearity problem can be considered negligible.

capita is controlled as a separate variable to fulfill the constant-effects assumption, and remove the effects of initial scores on subsequent gain. Results for the control variables are constant and the effects are statistically significant and positive as expected, reassuring the substantive interpretations on consistent effects of trade centralities. While wealthier countries continue to have higher rates of economic growth, increased transactional linkages with the international economy also foster significant positive instead of exploitative effects on a country's growth.

Economies and Growth

Since the period 1970-1978 was a peculiar interval for dependence studies, development theorists commonly place their focus of research exclusively on poor regions such as Third World countries and Latin America. Nonetheless, the effects of growing interdependence among countries on the global economy should be extensively studied across categories of countries or geographical regions. Moreover, the present study also regards the uniqueness of centrally planned economies and oil exporting countries which experienced the most extreme changes from a period of global crisis precipitated by two oil price shocks in the 1970s to the rise of the new international division of labor. According to Table 15, oil exporting countries (OEC)

and centrally planned economies (CPE) exhibit significant positive effects on economic growth compared to all other countries (the contrast group in the regression analysis) between 1970 and 1978. Oil exporting countries continued to have a significant, yet negative, association with economic growth in the period 1978-1990 (Table 16). For this reason, the analysis now turns to these two specific groups of countries.

In the following analysis, capital and labor centralities are omitted from the regression models due in part to their weak performances and also for the consistency of variable compositions in two time periods. Table 18 shows that the exclusion of centrally planned countries from the sample slightly improved the model's ability in explaining the variance - the R^2 increased from .207 to .224. However, the directions of effect and signs of significance of the predictor variables remained essentially the same with or without CPE.

Conversely, oil-exporting countries exerted considerable influence on regression coefficients for economic growth between 1970-1978. After omitting OEC from the sample, the initial significant positive effect of trade centrality for economic growth was explained away by two of the dependence variables: capital penetration and export intensity. One of the reasons is that the rapidly growing rate of OEC's national account during this period

Table 18. Regression Coefficients for Economic Growth 1970-1978 on Selected Independent Variables, by Models of Economies

	All Economies		CPE Excluded		OEC Excluded		CPE and OEC Excluded	
Independent Variable	b	Beta	b	Beta	b	Beta	b	Beta
Growth Rates								
Trade centrality (β=.8)	.237*** (.083)	.348	.226*** (.083)	.343	.111 (.082)	.175	.094 (.078)	.158
Capital penetration	-.211 (.238)	-.106	-.201 (.237)	-.105	-.391* (.220)	-.233	-.392* (.209)	-.251
Primary export dependence	.039 (.094)	.052	.006 (.094)	.008	.030 (.096)	.041	-.017 (.093)	-.025
Export intensity	-.118* (.067)	-.194	-.119* (.068)	-.200	-.131** (.061)	-.261	-.139** (.060)	-.292
Labor intensity	.154 (.333)	.058	.097 (.334)	.037	.230 (.321)	.130	.239 (.308)	.111
Capital intensity	.284 (.230)	.173	.265 (.231)	.167	.080 (.209)	.056	.052 (.200)	.039
Defense expenditure	.106 (.075)	.154	.100 (.078)	.146	.089 (.070)	.155	.099 (.070)	.177
Human capital investment	.164 (.184)	.111	.232 (.192)	.152	-.082 (.177)	-.061	-.056 (.180)	-.041
Control Effects								
1970 GNP per capita	.138** (.052)	.415	.150*** (.053)	.457	.120** (.048)	.421	.137*** (.047)	.503
Largest variance inflation factor	2.210		2.184		2.228		2.214	
R^2	.308		.332		.278		.325	
Adjusted R^2	.207		.224		.162		.203	
Number of cases	72		66		66		60	

*p<.10 **p<.05 ***p<.01

Note: CPE and OEC denote Centrally Planned Economies and Oil Exporting Countries, respectively.
b = unstandardized regression coefficient with standard error in parenthesis;
Beta = standardized regression coefficient.

Table 19. Regression Coefficients for Economic Growth 1978-1990 on Selected Independent Variables, by Models of Economies

	All Economies		CPE Excluded		OEC Excluded		CPE and OEC Excluded	
Independent Variable	b	Beta	b	Beta	b	Beta	b	Beta
Growth Rates								
Trade centrality (β=.8)	.478*** (.075)	.614	.541*** (.079)	.658	.342*** (.076)	.450	.407*** (.081)	.500
Capital penetration	.086 (.420)	.022	.229 (.434)	.059	.249 (.409)	.073	.489 (.422)	.142
Primary export dependence	-.065 (.092)	-.068	-.063 (.092)	-.065	-.068 (.127)	-.058	-.080 (.129)	-.066
Export intensity	-.137 (.101)	-.151	-.159 (.111)	-.164	-.105 (.099)	-.129	-.176 (.109)	-.200
Labor intensity	-.116 (.122)	-.092	-.194 (.125)	-.150	-.096 (.118)	-.089	-.176 (.122)	-.160
Capital intensity	.127 (.180)	.070	.074 (.200)	.037	.078 (.172)	.049	-.003 (.189)	-.002
Defense expenditure	-.025 (.074)	-.031	-.038 (.076)	-.046	-.076 (.073)	-.102	-.115 (.075)	-.150
Human capital investment	.101 (.167)	.057	.278 (.191)	.143	.189 (.162)	.119	.432** (.188)	.245
Control Effects								
1970 GNP per capita	.141** (.032)	.417	.143*** (.033)	.421	.158*** (.032)	.532	.160*** (.033)	.533
Largest variance inflation factor	1.702		1.813		1.753		1.878	
R^2	.544		.593		.528		.588	
Adjusted R^2	.478		.528		.452		.515	
Number of cases	72		66		66		60	

*p<.10 **p<.05 ***p<.01

Note: CPE and OEC denote Centrally Planned Economies and Oil Exporting Countries, respectively.
b = unstandardized regression coefficient with standard error in parenthesis;
Beta = standardized regression coefficient.

Table 20. Regression Coefficients for Economic Growth 1970-1990 on Selected Independent Variables, by Models of Economies

	All Economies		CPE Excluded		OEC Excluded		CPE and OEC Excluded	
Independent Variable	b	Beta	b	Beta	b	Beta	b	Beta
Growth Rates								
Trade centrality (β=.8)	.417*** (.095)	.451	.474*** (.097)	.502	.337*** (.102)	.369	.376*** (.106)	.406
Capital penetration	-.436* (.254)	-.169	-.423* (.247)	-.166	-.433 (.250)	-.177	-.413* (.243)	-.171
Primary export dependence	.136 (.098)	.161	.109 (.097)	.129	.037 (.139)	.032	-.012 (.140)	-.010
Export intensity	-.117* (.069)	-.175	-.109 (.069)	-.159	-.119* (.068)	-.182	-.114 (.068)	-.170
Labor intensity	.086 (.182)	.055	-.087 (.185)	-.055	.150 (.180)	.100	-.026 (.184)	-.017
Capital intensity	.237 (.237)	.135	.330 (.252)	.184	.264 (.242)	.149	.376 (.257)	.207
Defense expenditure	-.063 (.099)	-.072	-.014 (.099)	-.016	-.045 (.104)	-.049	-.003 (.104)	-.003
Human capital investment	-.065 (.189)	-.039	.093 (.199)	.054	-.143 (.209)	-.077	.035 (.222)	.018
Control Effects								
1970 GNP per capita	.256*** (.065)	.501	.296*** (.070)	.575	.293*** (.068)	.572	.336*** (.073)	.650
Largest variance inflation factor	2.131		2.378		2.083		2.312	
R^2	.471		.536		.499		.567	
Adjusted R^2	.394		.462		.419		.489	
Number of cases	72		66		66		60	

*p<.10 **p<.05 ***p<.01

Note: CPE and OEC denote Centrally Planned Economies and Oil Exporting Countries, respectively.
b = unstandardized regression coefficient with standard error in parenthesis;
Beta = standardized regression coefficient.

is unlikely to be affected by foreign investment rates. Besides, the condition that the total income of OEC increased much more rapidly than their total output, due to changes in the price of oil relative to other goods, obscured their status of export dependence.

Looking at table 19, results of the period 1978-1990 show that trade centrality is the most prominent variable in accounting for global economic growth across all regression models composed of different combinations of nations. The substantial increase of associations for trade centrality and growth between all-economies and CPE-excluded sample again indicates that centrally planned economies were still having difficulties in adopting a new role in the capitalist world-economy (Nee and Stark 1989; Sklair 1991). On the other hand, much less fluctuation in relative prices in oil products has magnified the significant and positive influences of trade centrality on economic growth. In addition, human capital investment became statistically significant in the sample excluding OEC and CPE. The investment in education may have shown its long-term positive effects for a country's development.

Table 20 shows that the effect between position in the trade network and economic growth for the pool years (1970-1990) mirrors that of the second period (1978-1990). Trade centrality attains significant positive effects on economic growth across all models. While capital penetration and

export intensity still exert statistically significant effects on economic growth, their effect is relatively modest.

Comparing Measures of Economic Growth

The relatively weak performance of the alternatively hypothesized variables may reflect the fact that previous research neglected the holistic feature of the global economy and the unique role played by individual nations in the international arena. Stated differently, most of the preceding studies were preoccupied by the political-economy ideology, and were aimed at exploring the exploitative potential of the world system. Consequently, measurements were latently designed to exert these asymmetric relationships between classes of countries.

To test this assumption, the initial dependent variables in the difference-of-logs models were substituted with two development indices - PQLI and HDI, both of which are constructed based on a country's position in the dichotomous world system. Table 21 reports the expected outcomes that the models are better explained by the dependence and industrialization variables - the adjusted R^2 is .702 for PQLI and .713 for HDI. While the effects of network centrality variables disappeared, four alternative explanatory variables: export intensity, labor intensity, capital intensity, and defense expenditure, developed

Table 21. Regression Coefficients for Economic Growth: Comparing Models of Dependent Variables

	PQLI (1978)		HDI (1990)	
Independent Variable	b	Beta	b	Beta
Economies				
OEC	-.186***	-.257	-.093*	-.147
	(.060)		(.050)	
CPE	.250***	.346	.109**	.171
	(.049)		(.045)	
All other countries	contrast		contrast	
Growth Rates				
Trade centrality (β=.8)	.008	.010	.066	.091
	(.064)		(.055)	
Capital centrality (β=.8)	.044	.039	——	——
	(.082)			
Labor centrality (β=.8)	.020	.031	——	——
	(.045)			
Capital penetration	-.006	-.003	.055	.015
	(.175)		(.288)	
Primary export dependence	.013	.015	-.060	-.068
	(.073)		(.064)	
Export intensity	.140***	.198	.074	.088
	(.049)		(.069)	
Labor intensity	-.103	-.033	.259***	.223
	(.249)		(.084)	
Capital intensity	.560***	.292	-.142	-.085
	(.168)		(.129)	
Defense expenditure	.055	.069	.090*	.120
	(.055)		(.051)	
Human capital investment	-.133	-.077	.024	.015
	(.135)		(.119)	
Control Effects				
1970 GNP per capita	.333***	.858	——	——
	(.040)			
1978 GNP per capita	——	——	.266***	.861
			(.023)	
Largest variance inflation factor	2.468		1.722	
R^2	.757		.758	
Adjusted R^2	.702		.713	
Number of cases	72		72	

*p<.10 **p<.05 ***p<.01

Note: CPE and OEC denote Centrally Planned Economies and Oil Exporting Countries, respectively. b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

statistically significant results. Not surprisingly, the results are quite consistent with those of dependency/world-system studies. Evidently, the compatibility of these results seems to narrow by indirect measures. Increasing network exchanges, direct and indirect, should have changed the direction and scope of measurements. Especially when the configurations of transactional interactions among countries are dramatically transformed by technological improvements, external influences and factors seem to be much broader and dynamic than political economy theorists usually imply.

Results for Reduced-Form Model

To find out if the effects of alternative explanatory variables on economic growth may have been suppressed, the regression models were reestimated without the intervening network variables. Table 22 reports the results for this reduced-form model. With the exceptions of significant differences between contrast groups of economies, none of the other coefficients for dependence, industrialization, defense expenditure, and human capital investment are statistically significant for two separate periods. As expected, however, capital penetration and capital intensity attain statistically significant effects on economic growth without the presence of centrality measures for the pool years (1970-1990). Meanwhile, the significant

Table 22. Regression Coefficients for Economic Growth 1970-1978, 1978-1990, and 1970-1990 on Reduced-Form Models

	1970-1978		1978-1990		1970-1990	
Independent Variable	b	Beta	b	Beta	b	Beta
Economies						
OEC	.280***	.450	-.376***	-.554	-.070	.602
	(.073)		(.073)		(.078)	
CPE	.110*	.177	.055	.079	.184*	.194
	(.065)		(.071)		(.107)	
All other countries	contrast		contrast		contrast	
Growth Rates						
Capital penetration	-.380	-.191	.019	.005	-.578**	-.224
	(.228)		(.453)		(.283)	
Primary export dependence	.109	.145	-.080	-.083	.119	.141
	(.095)		(.100)		(.112)	
Export intensity	-.079	-.129	-.041	-.045	-.073	-.108
	(.065)		(.108)		(.077)	
Labor intensity	.476	.178	-.120	-.095	.181	.115
	(.314)		(.133)		(.204)	
Capital intensity	.246	.150	.246	.136	.565**	.321
	(.216)		(.204)		(.269)	
Defense expenditure	.068	.099	-.027	-.034	-.127	-.146
	(.073)		(.080)		(.110)	
Human capital investment	.101	.068	.198	.113	-.081	-.048
	(.176)		(.188)		(.226)	
Control Effects						
1978 GNP per capita	.135***	.406	.170***	.507	.307***	.602
	(.050)		(.036)		(.078)	
Largest variance inflation factor	2.230		1.600		2.178	
R^2	.389		.478		.343	
Adjusted R^2	.289		.392		.235	
R^2 increment test#	-.080**		-.160***		-.157***	
Number of cases	72		72		72	

*p<.10 **p<.05 ***p<.01

#Comparing to models including centrality measures in table 15, 16, and 17. R^2 for 1970-78, 1978-90, and 1970-90 are .469, .638, and .499, respectively.

Note: CPE and OEC denote Centrally Planned Economies and Oil Exporting Countries, respectively. b = unstandardized regression coefficient with standard error in parenthesis; Beta = standardized regression coefficient.

effects of oil-exporting countries no longer exist. Further, F-tests on the increments to R^2 for additive network centrality variables are statistically significant in all three time periods.

Based on these findings, it would still be premature to suggest that increased involvement in the global economy is the exclusive solution or sufficient condition for promoting economic growth. Alternative external factors and internal determinants may provide contingent strategies for growth in the cases of less-developed countries or some nonincorporated regions in the global economic system. Looking at the overall economic system, however, the degree to which a country involves in the international transactional networks accounts for the most substantial influences. The results indicate that frequent and extensive contacts with the larger economic system are a necessary process for a country to attain economic growth.

CHAPTER SEVEN

CONCLUSION AND DISCUSSION

Conclusion

The effect of fast-growing international interdependence on national economic growth has been the focus of comparative sociology and development studies. Yet the ascendant forces affecting the development of national economies - an external view of system structure and integration into the international economy - are relatively neglected. Based on data for 93 nations over a 20-year period (1970-1990) from three transactional networks (93 x 93 matrices), I estimated the effects of involvement in the global trade, capital, and labor networks on economic growth. The results demonstrate that changes of structural positions in the external transaction networks have been important factors restructuring international global economic formation. Most importantly, increased transactional linkages within the international economy promote significant beneficial, rather than harmful, effects on a country's economic growth.

Following the claim of increasing globalization of economic activities, two dimensions of analyses were developed as the theme of this research. First, the analysis focuses on restructuring in the global production networks and transforming dominance in the economic

hierarchy. Second, the analysis aims at exploring the interplay between international linkages and economic growth.

Examining networks of trade, capital, and labor, the result shows that a global economic hierarchy can be identified as a continuum of roles rather than a stratified model or discrete clusters of countries, as world-systems analysts often employ. Furthermore, a number of countries have experienced drastic changes in their dominant positions in terms of rank and centrality score within the world economy. While the decrease of centrality score and rank occurs in countries across all regions in the world economy, most sharp increases are concentrated in the area of Asian Pacific and South Asia.

The analysis also supports the ecological view of vertical mobility in the multilevel economic hierarchy. The most noticeable change across all production networks is the extensive upward movements of positions in the subdominant level. Although the number of dominant countries remained virtually unchanged over the past two decades, the phenomenon of domination is one of somewhat stable but shifting alliances. Countries in the lower order level only achieved limited upward mobility.

Additionally, the trend of decentralization in multiple transactional networks is expected to continue for the entire system as well as for each major trading region.

While decentralization in network dominance refers simply to the geographical spread of economic activities across national boundaries, global interdependence implies a degree of functional integration between these internationally dispersed activities (cf. Dicken 1992). As the frequency of contact with the larger system and the scope of interaction among countries expanded, the effects of geographical proximity became less pronounced than position in the production networks in affecting global economy.

Using difference-of-logs models of multiple regression analysis, centrality positions in the trade network presented consistently significant positive effects on economic growth throughout the analysis, with the exception of the model excluding oil-exporting countries between 1970 and 1978. Debates between development studies were generally centered on the beneficial or deteriorated effects of economic growth using indirect measures such as position in the world system, investment or trade dependence, levels of industrialization, military expenditure, and human capital investment. The effects of external factors - transactional linkages through trade networks exert much more positive influence on economic growth net of these alternative determinants.

This sharp contrast in the results indicates that increasing extensive contacts, rather than cutting ties

with the international economy, may be the necessary processes in achieving economic growth. Moreover, the analysis shows that centrality variables using closeness measures, which emphasize the importance of both direct and indirect contacts and take the relative position of other countries into consideration, are better than those employing degree and competitive distance measures. Hence, indirect transactional interactions with other dominant countries also have provided positive effects for a country's economic performance, in addition to direct interactions (dyadic network flows).

To avoid the possibility of floor effects associated with GNP per capita, I include the initial levels of GNP as a separate variable to test the constant-effects assumption and remove the effects of initial scores on subsequent gains. The results provide the analysis with a substantive interpretation of GNP per capita and consistent effects of centrality variables. While wealthier countries continue to exhibit higher rates of economic growth, increased involvement in international economic activities also contribute to a country's growth.

Discussion

In a global perspective, it becomes immediately (and increasingly) apparent that the various national economies are highly interdependent. A complicated network of

multilateral linkages, affecting virtually every country, is generated by merchandise and service trade flows, unilateral transfers, short- and long-term capital flows, and labor migration (Klein, Pauly, and Voisin 1982). The degree of involvement in the global economy and the increasing economic internationalization and its impact on growth is becoming the major concern of development studies.

In the theoretical perspective, however, previous research was preoccupied with the political economy paradigm, which asserts that structural transformations are strictly confined by stratum memberships in the world system. Thus, involvement in the global system, as measured by position in the world system, determines asymmetric patterns of exchange and reinforces the reproduction of global inequality and hierarchy. Although the diffusionist perspective draws results from broader and more systematic cross-regional comparisons, the emphasis of an international normative order and pro-development ideology has to cut across the First World/Third World divide. Undoubtedly, these viewpoints are essentially internal views of system structure. Social systems are regarded as either normatively and institutionally integrated in space and as possessing a unit functional character, or endogenously generated from class interests and relations of production (Irwin and Kasarda 1994).

Briefly, the importance of international contact networks which develop outside individual social systems are neglected. The trend of growing interdependence in the global economy do not just influence the links between individual countries and the international system. When changes in several countries are mutually reinforcing or when the weight of a single national actor in the system is large, they may have the effect of restructuring the international system as a whole. Drawing on the external view of social and spatial hierarchy put forth by human ecologists, this research demonstrates that economic interdependencies developed in terms of network positions and changes in the network centralities have been pivotal factors reorganizing international economies and creating competitive advantages for economic growth for countries centrally located in the global production networks.

As for the dynamic feature of this research, network centralities have increasingly positive long term effects on economic growth over both time periods (1970-1978, 1978-1990). In the latter period (1978-1990), network interactions foster even greater effects on changes in relative dominant position and vertical mobility within the economic hierarchy. Besides, this trend of increasing contacts and interactions is interpenetrating countries across geographical regions and socio-economic systems.

China's open-door policy beginning in 1978 positively contributes to the fast-growing economy and strengthened regional integration in the Pacific Rim area.

A series of dramatic social changes occurred after 1990, such as the collapse of former Soviet Union, the reunion of East and West Germany, the initiation of the North America Free-Trade Agreement (NAFTA), the development of Asia-Europe Forum (ASEM), and possibly the creation of a trans-Atlantic free-trade area (TAFTA) between the European Union and the United States in the near future. These changes suggest a growing multilateralization and interdependence of these regional blocs. In addition, the present research shows that the overall network centralization has declined over the past two decades, suggesting that the degree to which a network is dominated by a few countries has decreased between 1970-1978 and 1978-1990. As the world economy continues to change from a regionally-integrated system to a globally-linked system, the transformation of the world economic hierarchy should become more of a multicentric structure. Hence, broad socio-spatial distinctions like core/periphery or First World/Third World should become less meaningful.

While the results of this analysis show extensive changes in network positions and upward mobility in the global economy, we have to note that international mobility is not a zero-sum game (Chase-Dunn 1983; Chirot 1977).

Clearly, upward mobility does not necessarily mean a reduction of global material inequality. As Dahrendorf (1959) asserts, the structure of a social formation remains the same, dominant and dominated groups, but the occupants change. Dominant and dominated are relative terms, not absolute.

Despite insignificant performances for capital and labor networks in predicting economic growth, these measures have been shown to be important factors explaining changes of a country's relative position and vertical movement in the global economic structure. The weak associations between capital network and growth may be due partly to its considerable sensitivity to regulation and policy of markets or incompatibility between political units (nations) and capital movements (multinational banks). A broader input using other network measures of capital investments including foreign aid, foreign direct investment, and foreign loans may enhance the levels of causal interpretations.

Due to a lack of measures for the extent and distribution of foreign employment between countries, the study of the relationship between labor movements (measured by ethnic diversity) and economic growth has focused on the links between the dominant ethnic group and foreign capital penetration. It is argued that ethnicity-state relationships can provide important incentives for state

elites to actively encourage the penetration of international capital, for the sake of sustaining the state in a form that insures that a given ethnic group keeps its privileged position in the state structure (Enloe 1980).

The present research has addressed a more immediate investigation between labor network and growth. However, the measure (nationality of foreign worker) employed is insufficient to separate the effects of "labor flow" from "labor stock" - refer to "current account inflows of foreign workers for some time period," and "total accumulated number of foreign-born workers in a country," respectively (cf. Firebaugh 1992, p.117). Stated differently, measures of labor stock may have incorporated influences from the factor of ethnic enclaves. Nonetheless, this preliminary analysis may provide useful directions for further measurement, with special attention paid to the dynamic and historical features of labor flows.

Thus, future research of multiple transactional networks in the growth of global economy must continue to explore the interrelations among overlapping exchange networks. In the globally networked economy, nations as competing organizational actors have to seek productive niches or necessary resources in the process of territorial spread and functional integration within the international economy. While network positions provide critical theoretical and empirical determinants of changes and

growth in the global economic structure, the interplay between economic, political, and technological factors have to be considered for a more comprehensive explanation of growing competition in the international arena.

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APPENDICES

Appendix A. Means, Standard Deviations, and Correlations for All Variables in the Analysis, 1970-1978

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Economic Growth Rate	1.000											
(2) PQLI	.168	1.000										
(3) Primary Export Dependence	-.063	.111	1.000									
(4) Export Intensity	-.166	.245	-.167	1.000								
(5) Capital Penetration	-.202	-.053	.401	-.071	1.000							
(6) Labor Intensity	.033	-.335	-.159	-.156	.044	1.000						
(7) Capital Intensity	.116	-.234	-.264	-.075	-.225	.186	1.000					
(8) Defense Expenditure	.089	-.117	-.039	-.012	-.065	.084	.001	1.000				
(9) Human Capital Investment	.048	-.392	-.136	.042	-.049	.228	.160	-.061	1.000			
(10) Trade Centrality (β=.8)	.409	-.123	-.262	.009	-.218	.209	.319	-.009	.228	1.000		
(11) Trade Centrality (β=.0)	.340	-.115	-.297	.048	-.271	.164	.393	.082	.175	.803	1.000	
(12) Trade Centrality (β=-.8)	.245	.177	-.051	-.005	.005	-.024	-.190	.016	-.094	.025	.109	1.000
(13) Labor Centrality (β=.8)	.098	-.072	-.276	-.062	-.204	.129	.043	.060	.093	.041	.125	-.062
(14) Labor Centrality (β=.0)	.053	-.138	-.204	-.098	-.104	.036	.006	.049	.005	.036	.099	-.054
(15) Labor Centrality (β=-.8)	-.099	-.076	-.217	.050	.049	.003	.031	-.056	.043	.003	.025	.129
(16) Capital Centrality (β=.8)	.121	.217	-.040	.140	-.028	.110	-.235	.011	-.023	.110	.109	.122
(17) Capital Centrality (β=.0)	.085	.166	.027	.021	-.019	.003	-.164	.114	.041	.003	.006	.095
(18) Capital Centrality (β=-.8)	.057	.066	.087	-.039	-.008	.019	-.066	-.017	.051	.019	.023	.080
(19) GNP per capita (1970)	.179	.711	.103	.109	-.008	-.445	-.531	-.163	-.418	-.092	-.054	.326
Mean	.43	1.80	-.12	.08	-.01	.04	.02	.05	.13	.00	.12	.00
Standard Deviation	.17	.20	.23	.28	.09	.06	.11	.25	.12	.25	.26	.01
Minimum	.04	1.18	-.97	-.46	-.32	-.11	-.19	-.54	-.03	-.88	-.68	-.04
Maximum	1.14	1.99	.58	1.16	.54	.27	.39	.85	.48	.80	1.08	.05

(Appendix con'd.)

Variables	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(13) Labor Centrality (β=.8)	1.000						
(14) Labor Centrality (β=.0)	.885	1.000					
(15) Labor Centrality (β=-.8)	.068	.220	1.000				
(16) Capital Centrality (β=.8)	.017	-.053	-.285	1.000			
(17) Capital Centrality (β=.0)	.086	.047	-.375	.659	1.000		
(18) Capital Centrality (β=-.8)	.104	.067	-.401	.345	.751	1.000	
(19) GNP per capita (1970)	.188	-.127	.053	-.131	-.067	.175	1.000
Mean	.07	.13	.00	.01	-.04	.00	2.77
Standard Deviation	.32	.35	.01	.18	.18	.02	.52
Minimum	-.99	-1.19	-.05	-.41	-.49	-.06	1.78
Maximum	1.32	1.23	.05	.56	1.06	.12	3.70

Note: Logged variables were used for all variables. Correlations among different centrality levels (variables 10 through 12, 13 through 15, and 16 through 18) and two dependent variables (variable 1 and 2) are reported but these variables never appear together in a model.

Appendix B. Means, Standard Deviations, and Correlations for All Variables in the Analysis, 1978-1990

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Economic Growth Rate	1.000												
(2) HDI	.482	1.000											
(3) Primary Export Dependence	-.198	-.016	1.000										
(4) Export Intensity	-.061	-.057	-.217	1.000									
(5) Capital Penetration	-.152	-.068	-.086	.561	1.000								
(6) Labor Intensity	-.205	.072	-.075	-.016	.155	1.000							
(7) Capital Intensity	.020	-.372	-.327	.274	.097	-.022	1.000						
(8) Defense Expenditure	-.011	.129	.145	-.143	-.062	.152	-.148	1.000					
(9) Human Capital Investment	-.156	-.124	-.002	.004	-.034	.351	.038	.033	1.000				
(10) Trade Centrality (β=.8)	.581	.119	-.298	.178	-.022	-.087	.165	.110	-.187	1.000			
(11) Trade Centrality (β=.0)	.200	-.173	-.253	.175	.047	.034	.172	.055	-.069	.733	1.000		
(12) Trade Centrality (β=-.8)	-.091	-.050	-.193	.172	.098	.030	-.011	-.001	.154	.096	.235	1.000	
(13) GNP per capita (1970)	.375	.759	.103	-.171	-.178	-.205	-.343	-.086	-.160	-.074	-.351	-.074	1.000
Mean	.24	-.14	-.08	.04	.00	-.07	-.01	.01	.08	-.02	.00	.06	3.20
Standard Deviation	.19	.18	.20	.21	.05	.15	.11	.24	.11	.25	.01	.27	.57
Minimum	-.36	-.84	-.73	-.94	-.25	-.48	-.48	-.75	-.18	-.09	-.03	-1.18	2.04
Maximum	.66	.00	.98	.56	.12	.30	.26	.84	.54	1.05	.02	.97	4.18

Note: Logged variables were used for all variables. Correlations among different centrality levels (variables 10 through 12) and two dependent variables (variable 1 and 2) are reported but these variables never appear together in a model.

Appendix C. Countries Included in Multiple Network Analysis

West Europe	North and Latin America
Australia	United States
New Zealand	Canada
Austria	Argentina
Belgium-Luxembourg	Bahamas, The[c]
Denmark	Barbados[c]
Finland	Brazil
France	Chile
German, Federal Republic of	Colombia
Greece	Costa Rica
Iceland	Cuba[c]
Ireland	Dominican Republic[c]
Italy	Ecuador
Netherlands	Honduras
Norway[c]	Jamaica[c]
Portugal	Mexico
Spain	Panama
Sweden	Peru
Switzerland	Uruguay[c]
United Kingdom	Venezuela[a]
East Europe	**North Africa and Southwest Asia**
Bulgaria[b]	Algeria[c]
Czechoslovakia[b]	Bahrain[c]
German Democratic Republic[c]	Egypt
USSR[c]	Iran[c]
Cyprus	Iraq[c]
Hungary[b]	Israel
Malta	Kuwait[a]
Poland[b]	Lebanon[c]
Romania[b]	Libya[a]
Turkey	Morocco
Yugoslavia	Saudi Arabia[a]
	Syrian Arab Republic[c]
Subsaharan Africa	**Asian Pacific and South Asia**
Angola[c]	Japan
Cameroon	Bangladesh
Congo	China[b]
Cote d'Ivoire[c]	Hong Kong
Ghana	India
Kenya	Indonesia[a]
Liberia	Korea, South
Malawi	Macau[c]
Mali	Malaysia
Mauritius	Pakistan
Nigeria[a]	Philippines
Rwanda	Singapore[c]
South Africa	Sri Lanka
Tanzania	Thailand
Tunisia	Vietnam[c]
Zambia	Taiwan[c]

[a]Oil Exporting countries.
[b]Centrally planned economies.
[c]Not included in the multiple regression models.

VITA

Kuo-Hua Chen was born in Pingtung, Taiwan on January 19, 1965. He graduated from Tsoying Municipal High School, Kaohsiung, Taiwan, in 1982, and then traveled to Taipei to begin his college career. Fu-Jen Catholic University awarded him a B.A. degree in Sociology, in June 1986. After two-years of military service in the Army and one year as a research assistant in Taipei Municipal Teacher's College, he came to Louisiana and began his graduate studies in Sociology at Louisiana State University in Baton Rouge. He received an M.A. degree in Sociology in May, 1991. At present, he is working under the direction of Dr. Michael D. Irwin and Dr. Joachim Singelmann. He is currently a candidate for the degree of Doctor of Philosophy in The Department of Sociology at Louisiana State University.

DOCTORAL EXAMINATION AND DISSERTATION REPORT

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Title of Dissertation: Transactional Interactions and Growth in the Global Economy: A Multiple-Network Analysis

Approved:

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EXAMINING COMMITTEE:

Date of Examination:

March 7, 1996